

# New *Dryocosmus* Giraud species associated with *Cyclobalanopsis* and non-*Quercus* host plants from the Eastern Palaearctic (Hymenoptera, Cynipidae, Cynipini)

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## Abstract

Our knowledge about gall wasps associated with the diverse East Asian oaks, *Castanopsis* and *Cyclobalanopsis*, is limited due to the lack of extensive field studies. Here, we describe twelve new oak gall wasp species, *Dryocosmus cannoni* Schwéger & Tang, *D. caputgrusi* Tang & Schwéger, *D. crinitus* Schwéger & Tang, *D. harrisonae* Melika & Tang, *D. hearni* Melika & Tang, *D. hualieni* Schwéger & Tang, *D. konradi* Tang & Melika, *D. liyingi* Melika & Tang, *D. moriius* Tang & Melika, *D. quadripetiolus* Schwéger & Tang, *D. salicinai* Schwéger & Tang, and *D. taitungensis* Tang & Melika, from Taiwan and mainland China. Seven newly described species induce galls on *Quercus* subgenus *Cyclobalanopsis* and five on other Fagaceae genus, *Castanopsis*. All of the new species concepts are supported by morphological and molecular data. We provide descriptions, diagnoses, host associations for the new species and an illustrated identification key to Eastern Palaearctic *Dryocosmus* species. We represent natural language phenotypes in a semantic format supported by biomedical ontologies to increase the accessibility of morphological data.

## Keywords

Cynipidae, *Dryocosmus*, *Plagiotrochus*, *Cyclobalanopsis*, *Castanopsis*, *Lithocarpus*, *Castanea*, biology, morphology

## Introduction

Oak gallwasps (Hymenoptera: Cynipidae: Cynipini), with about 1000 species, are the most species-rich cynipid lineage (Csóka et al. 2005). Most cynipine species are associated with oaks of the *Quercus* L. subgenus *Quercus* L. in the Western Palearctic and Nearctic (Stone et al. 2002, 2009, Abe et al. 2007). Although the other *Quercus* subgenus, the Asian *Cyclobalanopsis* (Oersted) C. K. Schneider, is represented by 76 species (Govaerts and Frodin 1998, Manos and Stanford 2001), our knowledge about *Cyclobalanopsis* associated cynipines is restricted to a few, recently described taxa (Abe et al. 2014a, b, Ide et al. 2010, 2012, 2013, Melika et al. 2011, 2013, Tang et al. 2011a, b, 2016a, b).

Similarly to *Cyclobalanopsis*, East Asia is also a diversity center for three other Fagaceae genera. The tropical and subtropical *Castanopsis* Miller is represented with 134 species in Asia and Malesia; the 325 species of *Lithocarpus* Blume (= *Pasania* (Miq.)) occur almost entirely in Asia and Malesia (one species in the western North America), and the 8 species of *Castanea* Miller are distributed in the Northern Hemisphere (Govaerts and Frodin 1998). Associations between East Asian representatives of these Fagaceae genera and Cynipini have been revealed only very recently (Tang et al. 2011a and Tang et al. 2016a).

Of the ten Eastern Palearctic *Dryocosmus* species, *D. sakureiensis* Ide, Wachi & Abe, *D. sefuriensis* Ide, Wachi & Abe, are associated with *Cyclobalanopsis*, four species, *D. carlesiae* Tang & Melika, *D. pentagonalis* Melika & Tang, *D. testisimilis* Tang & Melika, *D. triangularis* Melika & Tang, with *Castanopsis*, two species, *D. kuriphilus* (Yasumatsu), and *D. zhuili* Liu & Zhu, with *Castanea*. Hosts of *Dryocosmus nanlingensis* Abe, Ide, & Odagiri and *D. okajimai* Abe, Ide, Konishi & Ueno are unknown (Abe et al. 2014a, b, Ide et al. 2010, 2012, 2013, Melika et al. 2011, 2013, Tang et al. 2011a, b, Zhu et al. 2015). Ide and Abe (2015) described a new cynipine species, *Dryocosmus kunugiphagus*, from a section Cerris oak, *Quercus acutissima* Carruth, as the first *Dryocosmus* species developing on section Cerris oaks in the Eastern Palearctic. This species shares numerous diagnostic features with *Plagiotrochus* and lack key character states of *Dryocosmus* (e.g. in *D. kunugiphagus* the mesoscutum is rugose, with dense setae, the mesopleuron rugose and the apical setae of the ventral spine of hypopygium do not form a truncate apical tuft; Melika et al. 2010, Ide and Abe 2015), thus we did not treat *Dryocosmus kunugiphagus* in the present paper.

In this study we double the number of *Dryocosmus* species associated with non-subgenus *Quercus* oaks and describe twelve new *Dryocosmus* species from Taiwan and four from mainland China. Seven of these, *Dryocosmus crinitus* Schwéger & Tang, *D. hualieni* Schwéger & Tang, *D. konradi* Tang & Melika, *D. liyingi* Melika & Tang, *D. moriis* Tang & Melika, *D. salicinai* Schwéger & Tang, and *D. taitungensis* Tang

& Melika, are associated with *Cyclobalanopsis* and five species, *D. cannoni* Schwéger & Tang, *D. caputgrusi* Tang & Schwéger, *D. harrisonae* Melika & Tang, *D. hearni* Melika & Tang, *D. quadripetiolus* Schwéger & Tang, with *Castanopsis*.

## Materials and methods

Galls were collected from *Castanopsis* and *Quercus* subgenus *Cyclobalanopsis* species in Taiwan and China in March 2011 and 2012 from the following localities: Taiwan: *Castanopsis carlesii* (Hemsley) Hayata and *C. uraiiana* (Hayata) Kaneh. & Hatus at Taoyuan and Taitung Counties; *Q. glauca* Thunb. in Murray at Hualien and Nantou Co., *Q. morii* Hayata and *Q. longinux* Hayata at Nantou Co., *Q. hypophaea* Hayata at Taitung Co., *Q. salicina* Blume at Taichung Co., *Q. sessilifolia* Blume at New Taipei City, China: *Castanopsis echinocarpa* Miq. at Yunnan Province, Xishuangbanna Lan Cang County and Xishuangbanna, Yunnan Province; *Castanopsis* sp.4 at Lan Cang County, Yunnan Province. Galls were kept at room temperature in plastic containers with openings on the lids that were covered with meshes to keep ventilation. Emerged adult wasps were preserved in 99% ethanol.

The type material is deposited in the following institutions: NMNS, National Museum of Natural Science, Taichung, Taiwan (curator M.L. Jeng); PHMB, Plant Health and Molecular Biology Laboratory, National Food Chain Safety Office, Budapest, Hungary (curator G. Melika); NCHU, Department of Entomology, National Chung Hsing University, Taichung, Taiwan (curator M.-M. Yang); USNM, U.S. National Museum of Natural History, Smithsonian Institution, Washington, DC, U.S.A. (curator M. Buffington).

Bright field images of adults and galls were produced with a digital Leica DC500 camera attached to a Leica DM2700M compound microscope using the LAS Store&Recall software, followed by processing in Adobe Photoshop 6.0. High resolution plates are available from Figshare (<https://dx.doi.org/10.6084/m9.figshare.3837915.v1>).

Anatomical terms were matched to concepts in the Hymenoptera Anatomy Ontology (Yoder et al. 2010) and a URI table (Suppl. material 1) containing morphological terms, definitions and Uniform Resource Identifiers resolved at <http://hymao.org> were generated using the text analyzer function (Seltmann et al. 2013, <http://portal.hymao.org/projects/32/public/ontology/>).

Matrix-based descriptions were generated using mx (<http://purl.org/NET/mx-database>). Terminology of morphological statements used in descriptions, identification key and diagnoses are mapped to relevant biomedical ontologies (Hymenoptera Anatomy Ontology (HAO), Phenotypic Quality Ontology (PATO), Biospatial Ontology (BSPO), Common Anatomy Reference Ontology (CARO); available at <http://obofoundry.org/>).

We represent natural language phenotypes in an Entity: Quality (EQ) format: Entity attribute: value. Semantic statements of natural language phenotypes (Suppl. material 2) were composed in Protégé 5.0 (<http://protege.stanford.edu/>) using the OWL Manchester syntax (<http://www.w3.org/TR/owl2-manchester-syntax/>) following Balhoff et al. (2013) and Mikó et al. (2014).

The full data set, represented in OWL (Web Ontology Language; <http://www.w3.org/TR/owl2-overview/> last accessed February 4, 2014), was deposited as a Resource Description Framework (RDF)-XML file (<http://www.w3.org/TR/REC-rdf-syntax/> in Github ([https://github.com/hymao/hymao-data/blob/master/Tang\\_et\\_al\\_dryocosmus\\_merged.owl](https://github.com/hymao/hymao-data/blob/master/Tang_et_al_dryocosmus_merged.owl)).

The phenotypic descriptors “glossy and matte” ([http://purl.obolibrary.org/obo/PATO\\_0001373](http://purl.obolibrary.org/obo/PATO_0001373)), refer to the reflectance quality of the cuticle. These relation phenotypes can only be observed under direct light (without light diffusers) and might correlate to the cuticular hydrocarbon profile (Hora et al. 2007, 2010).

The phenotypic descriptor “smooth” refers to the sculpture quality of a cuticular region that lacks “leathery” microsculpture (Ball 1985). Hexagonal sculptural elements (scutes, [http://purl.obolibrary.org/obo/HAO\\_0002430](http://purl.obolibrary.org/obo/HAO_0002430)) of this microsculpture type most likely correspond to epidermal cells (Hinton 1970, Moretto 2015). Sculptures with convex scutes surfaces are referred here as “coriaceous” while that of flat scute surfaces are named “alutaceous”.

Species concepts of the present paper were also examined using genetic data. Part of the mitochondrial cytochrome b (cyt *b*) gene was amplified from extractions of whole genomic DNA from between one and four individuals per species using the primers CB1/CB2 or CB1/CP2, following protocols in Nicholls et al. (2010). PCR products were cleaned up using a standard SAP/ExoI protocol, then sequenced in both directions using BigDye v3.1 terminator chemistry and run on an ABI3730 capillary sequencer. Base calls were confirmed by eye using Sequencher version 4.10.1 (Gene Codes Corporation 1995). Sequence data for the corresponding fragment were also obtained for two or three individuals of four previously described *Dryocosmus* species: *D. carlesiae*, *D. pentagonalis*, *D. testisimilis*, *D. triangularis*. Pairwise distances between all individuals were determined in PAUP\* v4.0b10 (Swofford 1998) using a HKY model of sequence evolution, then average within- and between-species distances were calculated for each species-level comparison.

## Results

### Molecular markers

A 433 base-pair fragment of the cyt *b* gene was successfully amplified for between one and six individuals of each species; in total 49 sequences were obtained from 17 species (GenBank accession numbers KU760807–KU760855). Variation within species was minimal, ranging from 0 to 1.6% (Table 1, values on diagonal). Variation between all species, both new ones described herein and previously described taxa, was greater than 6.9% for all comparisons except the one between *D. harrisonae* and *D. cannoni* (2.0%), and in some instances was greater than 20% (Table 1). These values are consistent with those expected for within- and between-species variation both in gall wasps (Nicholls et al. 2012) and among insects in general (Hebert et al. 2003), supporting the distinctiveness of the newly described *Dryocosmus* species.



**Table 1.** Pairwise genetic distances between 17 *Dryocosmus* species, based upon 433 base pairs of the cytochrome *b* gene using a HKY correction. Values on the diagonal indicate variation levels among individuals of the same species; off-diagonal values indicate between-species distances.

	<i>D. cannoni</i>	<i>D. caputgrusi</i>	<i>D. crinitus</i>	<i>D. harrisonae</i>	<i>D. bearni</i>	<i>D. bualieni</i>	<i>D. konradi</i>	<i>D. liyingi</i>	<i>D. morius</i>	<i>D. quadripetiolus</i>	<i>D. salicinal</i>	<i>D. taitungensis</i>	<i>D. carlesiae</i>	<i>D. kuriphilus</i>	<i>D. pentagonalis</i>	<i>D. testisimilis</i>	<i>D. triangularis</i>
<i>D. cannoni</i>	0.00																
<i>D. caputgrusi</i>	0.09	-															
<i>D. crinitus</i>	0.20	0.18	0.01														
<i>D. harrisonae</i>	0.02	0.09	0.19	0.00													
<i>D. bearni</i>	0.28	0.29	0.28	0.30	0.00												
<i>D. bualieni</i>	0.26	0.25	0.24	0.25	0.29	0.00											
<i>D. konradi</i>	0.17	0.16	0.19	0.18	0.27	0.18	0.01										
<i>D. liyingi</i>	0.21	0.21	0.25	0.22	0.33	0.26	0.20	0.02									
<i>D. morius</i>	0.19	0.16	0.18	0.19	0.27	0.20	0.16	0.22	0.01								
<i>D. quadripetiolus</i>	0.09	0.07	0.19	0.09	0.29	0.27	0.14	0.22	0.18	0.00							
<i>D. salicinal</i>	0.20	0.17	0.21	0.19	0.29	0.22	0.17	0.24	0.11	0.19	0.00						
<i>D. taitungensis</i>	0.18	0.13	0.20	0.18	0.29	0.26	0.16	0.23	0.21	0.15	0.21	0.01					
<i>D. carlesiae</i>	0.15	0.15	0.22	0.16	0.29	0.24	0.19	0.25	0.19	0.16	0.19	0.15	0.00				
<i>D. kuriphilus</i>	0.17	0.14	0.24	0.16	0.29	0.23	0.16	0.22	0.20	0.15	0.18	0.18	0.18	0.00			
<i>D. pentagonalis</i>	0.11	0.08	0.19	0.12	0.27	0.23	0.15	0.20	0.19	0.11	0.20	0.16	0.17	0.14	0.00		
<i>D. testisimilis</i>	0.17	0.18	0.28	0.18	0.28	0.24	0.22	0.20	0.23	0.20	0.24	0.19	0.19	0.20	0.19	0.00	
<i>D. triangularis</i>	0.11	0.10	0.18	0.11	0.26	0.23	0.16	0.19	0.18	0.12	0.18	0.17	0.17	0.15	0.07	0.19	0.00

## Morphology

### *Dryocosmus* Giraud, 1859

**Description.** Clypeus ventral margin shape: straight; Malar striae count: present; Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area; Malar area: alutaceous; Malar sulcus: absent; Impression around central ocellus: present; Postgenal bridge / length of oral foramen:  $<1$ .

Transverse pronotal sulcus depth: deep; Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum; Mesoscutum sculpture: smooth or delicately alutaceous; Mesoscutum reflectivity: glossy; Metanotal trough sculpture: smooth; Metanotal trough reflectivity: glossy; Metascutellum sculpture: coriaceous; Scutellar foveae count: present; Foveal septum count: present or absent; Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid or quadrangular. Subaxillular bar sculpture: smooth; Subaxillular bar reflectivity: glossy; Mesoscutellar axillar complex posterior margin vs metanotum: overhanging; Mesopleuron sculpture: smooth, mostly glossy, only partially coriaceous; Speculum sculpture: smooth, mostly glossy, only partially coriaceous; Lateral propodeal carinae count: present; Central propodeal area reflectivity: glabrous; Lateral propodeal area pilosity: present; Nucha sculpture: with delicate longitudinal rugae dorsally and laterally; Wings fully developed; Marginal cilia: long; R1 distal end vs wing margin: adjacent to wing margin; Rs distal end vs wing margin: adjacent to wing margin.

Metasoma lateral height / metasoma lateral length:  $<1$ ; Metasoma length / head+mesosoma length:  $<1$ ; Second metasomal tergite sculpture: smooth; Metasomal tergites 3-6 reflectivity: glossy; Distal end of ventral spine of hypopygium shape: acute or rounded distallyapically; Prominent part of ventral part of hypopygium length / width:  $< 3.5$ ; ventral part of hypopygium seta length: short.

**Diagnosis.** Most similar to *Plagiotrochus* Mayr by sharing the following character states: lower face with striae radiating from clypeus to inner margin of eye (sometimes indistinct because of short malar space), malar sulcus absent; lateral propodeal carinae curved outwards, median longitudinal carina sometimes present; central propodeal area with rugae; metasoma strongly compressed laterally; ventral spine of hypopygium short, acute or rounded apically, with or without a dense truncate tuft, prominent part  $< 3.5$  times as long as broad (Melika et al. 2010).

*Dryocosmus*: mesoscutum smooth or alutaceous; ventral spine of hypopygium with setae forming a truncate apical tuft.

*Plagiotrochus*: mesoscutum entirely coriaceous or rugose; ventral spine of hypopygium with setae not forming a truncate apical tuft.

## Key to *Dryocosmus* species

- 1 Mesosoma orange-yellow, metasoma light brown, female head orange-yellow to light brown, male head orange-yellow to dark brown ..... **2**
- Body dark brown to black, with some minute, light brown areas..... **3**
- 2 Notaulus posterior region width / notaulus anterior region width = 5 (not: Fig. 73); posterior height of subaxillular bar / height of metanotal trough = 0.25 (sab, mtr: Fig. 72); central propodeal area with transverse carina (trc: Fig. 74) in dorsal 1/3rd and with longitudinal parallel rugae between transverse carina and nucha (Fig. 74) .....  
..... ***Dryocosmus hearni* Schwéger & Tang, sp. n.**
- Notaulus anterior region width / notaulus posterior region width=1 (not: Fig. 181); posterior height of subaxillular bar / height of metanotal trough >1.00; central propodeal area without transverse carina in dorsal 1/3rd and with irregular rugae between dorsal propodeal margin and nucha (Fig. 180).....  
..... ***Dryocosmus testisimilis* Tang & Melika, 2011**
- 3 Basal lobe on metatarsal claw present..... **4**
- Basal lobe on metatarsal claw absent ..... **5**
- 4 Number of flagellomeres (female): 12; eye height / malar distance = 2.6; intertorular distance / eye torulus distance = 0.70; radial cell length / radial cell width = 3.40 ; 2nd metasomal tergite length dorsal view / length of metasoma dorsal view  $\geq 0.50$ ; prominent part of ventral spine of hypopygium length ventral view / prominent part of ventral spine of hypopygium width ventral view = 2.2 ..... ***Dryocosmus sakureiensis* Ide, Wachi & Abe, 2013**
- Number of flagellomeres (female): 13 (Fig. 126); eye height / malar distance = 2.0; intertorular distance / eye torulus distance = 0.40 (Fig. 122); radial cell length / radial cell width = 4.50 (rad: Fig. 129); 2nd metasomal tergite length dorsal view / length of metasoma dorsal view = 0.33; prominent part of ventral spine of hypopygium length ventral view / prominent part of ventral spine of hypopygium width ventral view = 1.3 (vsh: Fig. 132).....  
..... ***Dryocosmus moriis* Tang & Melika, sp. n.**
- 5 Dense setae present on lateral mesopleural surface ventral to transepisternal line (tel: Fig. 142) .... ***Dryocosmus quadripetiolus* Schwéger & Tang, sp. n.**
- Mesopleuron glabrous or few setae present along posteroventral margin of lateral mesopleural surface (Figs 24, 40, 72, 166)..... **6**
- 6 Striae marking transepisternal line extends  $\frac{3}{4}$  of mesopleuron length (tel: Fig. 24) ..... **7**
- Striae marking transepisternal line absent (Fig. 99) or not extends  $\frac{1}{2}$  of mesopleuron length (tel: Figs 84)..... **10**
- 7 Speculum striate (spe: Fig. 24) ..... **8**
- Speculum without striae ..... ***Dryocosmus zhuili* Liu & Zhu, 2015**

- 8 Female POL/OOL = 1.40 (Fig. 2); male eye height / malar distance = 8.1; male eye height / transfacial distance = 1.2 (Fig. 5); male pedicel length / scape length < 1 (Fig. 10).....**9**
- Female POL/OOL = 1.80 (Fig. 176); male eye height / malar distance = 8.70; male eye height / transfacial distance = 1.40 (Fig. 177), male pedicel / scape = 1 .....***Dryocosmus triangularis* Tang & Melika, 2011**
- 9 Disc of mesoscutellum glossy and smooth at least in anterior half (dms: Figs 25, 26).....***Dryocosmus caputgrusi* Tang & Schwéger, sp. n.**
- Disc of mesoscutellum entirely rugose, matt (dms: Fig. 178) .....***Dryocosmus pentagonalis* Tang & Melika 2011**
- 10 Mesopleuron and speculum matt, uniformly coriaceous, without striae.....***Dryocosmus salicinai* Schwéger & Tang, sp. n.**
- Mesopleuron glossy, smooth without striae (Fig. 99) or with few delicate indistinct striae marking transepisternal line (tel: Figs 84).....**11**
- 11 Mesopleuron and speculum smooth, without striae (Fig. 113).....**12**
- Mesopleuron with few delicate indistinct striae marking transepisternal line (tel: Figs 166, 182, 184) .....**18**
- 12 Second metasomal tergite with multiple setae laterally (Fig. 87) .....**13**
- Second metasomal tergite without or few setae laterally (Fig. 119).....**14**
- 13 Scutellar foveae without longitudinal striae (scf: Fig. 100); female F1 / F2 = 1.00; female F1 / pedicel = 2.7; placoid sensilla present on F1–F12 (Fig. 97) ...***Dryocosmus konradi* Tang & Melika, sp. n.**
- Scutellar foveae with longitudinal striae (scf: Fig. 83); female F1 / F2 < 1; Female F1 / pedicel = 1.6; placoid sensilla present on F2–F12 (Fig. 81) .....***Dryocosmus hualieni* Schwéger & Tang, sp. n.**
- 14 Scutellar fovea minimum diameter / foveal septum width = 3.00; anterior pits of foveal septum present. ***Dryocosmus okayimai* Abe, Ide, Konishi & Ueno, 2014**
- Scutellar fovea minimum diameter / foveal septum width = 6.00–10.00; anterior pits on foveal septum absent (Fig. 183) .....**15**
- 15 Disc of mesoscutellum with irregular rugae (dms: Fig. 183).....***Dryocosmus carlesiae* Tang & Melika, 2011**
- Disc of mesoscutellum without irregular rugae (dms: Fig. 116) .....**16**
- 16 Transverse pronotal sulcus not foveolate (tps: Fig. 40); pronotum posterolaterally with few short rugae as long as or shorter than diameter of anterior thoracic spiracle (Fig. 40).....**17**
- Transverse pronotal sulcus foveolate (tps: Fig. 113); pronotum posterolaterally with numerous long rugae 2–3 times as long as diameter of anterior thoracic spiracle (Fig. 113).....***Dryocosmus liyingi* Melika & Tang, sp. n.**
- 17 Central propodeal area with 1–2 delicate longitudinal lateral rugae (cpa: Fig. 42).....***Dryocosmus crinitus* Schwéger & Tang, sp. n.**
- Central propodeal area with numerous irregular longitudinal and transverse lateral and medial rugae .....***Dryocosmus nanlingensis* Abe, Ide & Odagiri, 2014**



- 18 Speculum striate dorsally (spe: Fig. 166) .....  
 ..... ***Dryocosmus taitungiensis* Tang & Melika, sp. n.**
- Speculum without striae (spe: Figs 11, 55, 184)..... **19**
- 19 Triangular mesopleural furrow present; frons, interocellar area, vertex glossy, smooth, if frons alutaceous than only in lateral part, along compound eye....  
 ..... ***Dryocosmus sefuriensis* Ide, Wachi & Abe, 2013**
- Triangular mesopleural furrow absent; frons, interocellar area, vertex alutaceous or coriaceous (Figs 184–185) ..... **20**
- 20 Head width / head height >1; gena broadened behind eye, visible in frontal view along entire lateral eye margin (gen: Fig. 186) .....  
 ..... ***Dryocosmus kuriphilus* Yasumatsu, 1951**
- Head width / head height = 1; gena not or very slightly broadened behind eye, not visible in frontal view or only visible along ventral region of lateral eye margin (gen: Figs 1, 48) ..... **21**
- 21 Parapsidal line and median mesoscutal line present (pl, mml: Fig. 12).....  
 ..... ***Dryocosmus cannoni* Schwéger & Tang, sp. n.**
- Parapsidal line and median mesoscutal line absent (Fig. 56) .....  
 ..... ***Dryocosmus harrisonae* Melika & Tang, sp. n.**

***Dryocosmus cannoni* Schwéger & Tang, sp. n.**

<http://zoobank.org/1466DED3-5B57-474D-89FA-20A2B1A4356F>

Figures 1–17

**Type material.** HOLOTYPE female: CHINA: Yunnan Prov., Xishuangbanna, roadside near Meng Hai 2, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI84), 21.955322°N, 100.598178°E, 1388m, ex ball gall, with a long point on a long stalk from leaf or bud (AGWP-Morpho73), em. 17.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn. One male PARATYPE: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI87), 21.968800°N, 100.600883°E, 1388m, ex ball gall with a long point on a long stalk from leaf or bud (AGWP-Morpho73), em. 18.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn.

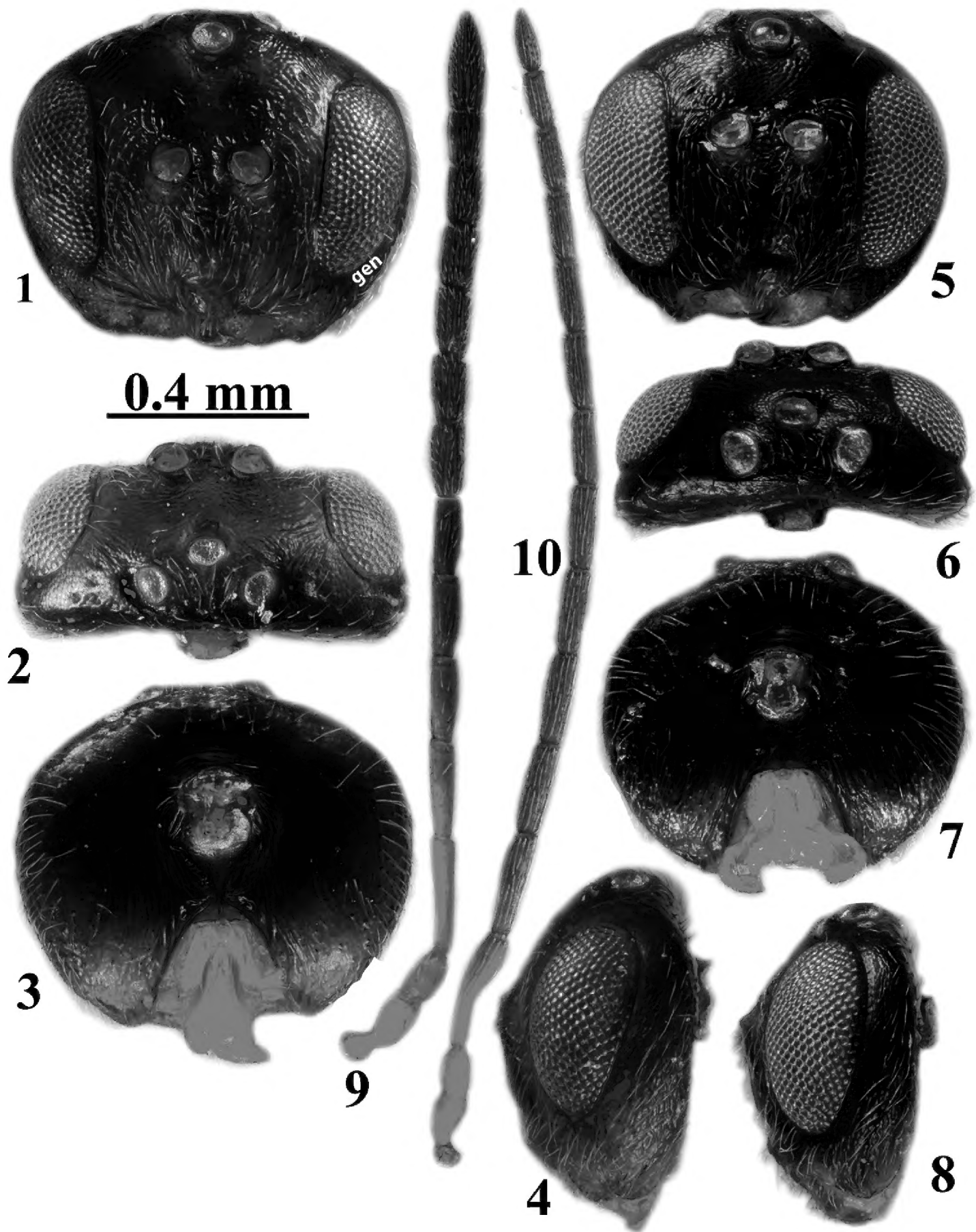
The female holotype and the male paratype are deposited in PHMB.

**Etymology.** Named after Prof. Chuck Cannon (Xishuangbanna Tropical Botanical Garden, Yunnan, China).

**Diagnosis.** *Dryocosmus cannoni*, *D. harrisonae*, *D. sefuriensis* and *D. kuriphilus* belong to the group of species in which the area dorsal to the transepisternal line is delicately striate anteriorly and the speculum lacks striae.

*Dryocosmus cannoni* is most similar to *Dryocosmus harrisonae*, sharing the presence of a slightly broadened gena visible only ventrally along the lateral eye margin.

*Dryocosmus cannoni*: parapsidal line and median mesoscutal line present (Fig. 12); placoid sensilla present on female F4–F12 (Fig. 9); scutellar foveae semilunar, with longitudinal parallel rugae; foveal septum absent (Fig. 13).

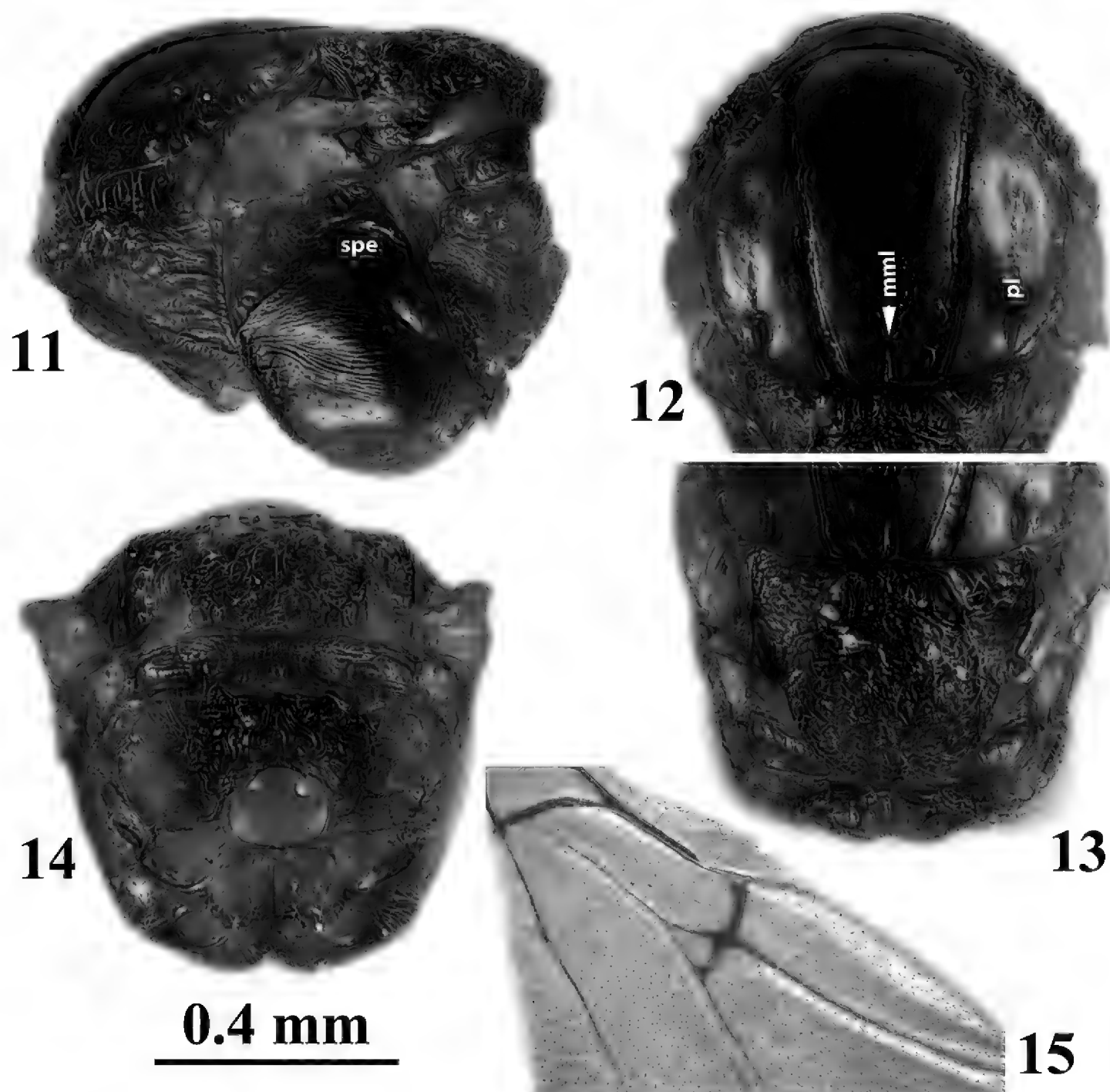


**Figures 1–10.** *Dryocosmus cannoni* sp. n. 1–4 head, female: 1 frontal view 2 dorsal view 3 posterior view 4 lateral view 5–8 head, male: 5 frontal view 6 dorsal view 7 posterior view 8 lateral view 9–10 antenna: 9 female 10 male (gen=gena).

*Dryocosmus harrisonae*: parapsidal line and median mesoscutal line absent (Fig. 56); placoid sensilla present on female F2–F12 (Fig. 53); scutellar foveae transversely ovate, without rugae; foveal septum present (Fig. 57).

**Description.** Sexual female: Head color: brown; mandibles, maxillary and labial palps yellowish; scape and pedicel yellow, flagellomeres progressively darker. Mesosoma and metasoma color: dark brown to reddish brown, except for lighter tegula, propodeum, and posterior half of metasoma, legs yellow.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 1.90. Head width / head height: 1.15. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.50. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar striae count: present. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.85. Inner margins of eyes: converging ventrally. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.0. OOL / diameter of lateral ocellus: 2.0. OOL / LOL: 2.10. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.10. Diameter of torulus / intertorular distance: 1.20. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.10. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: rare. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: coriaceous. Frons pilosity density: rare. Frons reflectivity: glossy. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: glossy. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: glossy. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: glossy. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: NOT CODED. Impression adjacent ventrally to posterior tentorial pit: NOT CODED. Postgena sculpture: alutaceous with some sub-parallel delicate longitudinal wrinkles. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: <1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: 1.70. Pedicel length / length of broadened part of scape: 1.0. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1.25. F1 length / pedicel length: 2. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length



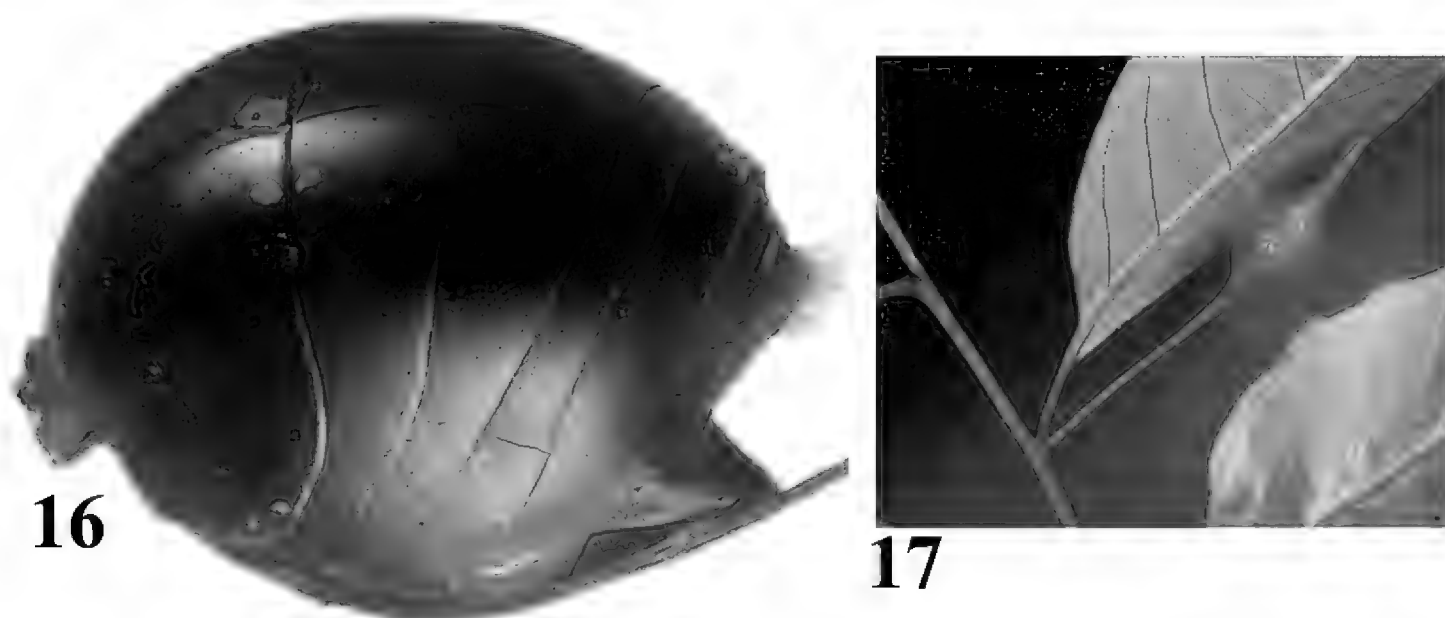
**Figures 11–15.** *Dryocosmus cannoni*, female, sp. n. **11** mesosoma, lateral view **12** mesoscutum, dorsal view **13** mesoscutellum, dorsal view **14** metascutellum and propodeum, posterodorsal view **15** fore wing, part (mml=median mesoscutal line, pl=parapsidal line, spe=speculum).

/ F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: 1.76. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F4–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.2. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED.



Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: foveolate. Median mesoscutal line: present. Median mesoscutal line shape: NOT CODED. Parapsidal line: present. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): rugose medially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: semilunar. Scutellar fovea reflectivity: glossy. Foveal septum: absent. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: NOT CODED. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: smooth, striae corresponding to transepisternal line extending 0.5 of mesopleural length, area dorsal to transepisternal line transversely striate. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: coriaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture in upper 1/3 of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 2. Central propodeal area sculpture: smooth with irregular rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: smooth with irregular rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: white. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.4. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M



**Figures 16–17.** *Dryocosmus cannoni*, sp. n. **16** metasoma, female, lateral view **17** gall (photo by C.-T. Tang).

color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/3. Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, micropunctate. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.20. Hypopygial setae apical end: not extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.30 mm (n=1).

Male: Color: Head, mesosoma and metasoma dark brown; antenna light brown. Eye size vs female eye size: Eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of torulus / intertorular distance: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus: 1.40. Flagellomeres count: 13. Antenna length / body length: >1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 1.07. Flagellomeres relative length: F2>F3>F4>F5>F6>F9>F10>F11>F12. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F2–F13. Body length: 2.2 mm (n=1).

Gall (Fig. 17): The main body of the gall is located on a long, thin stalk, 1.5–2.1 mm long, growing from the base of the petiole or midrib of the leaf. The gall body contains a spherical part 6.0–8.1 mm in diameter and a needle-like projection at the top of the gall body nearly the same length as the gall diameter. The gall is green, surface smooth; parenchyma is green and succulent. Unilocular, with a centrally

located larval chamber. The gall development coincides with sprouting of the host-plant in April.

**Biology.** Only the sexual generation is known. Galls were collected from *Castanopsis echinocarpa* in April; adults emerge from galls under laboratory conditions immediately after field collection.

**Distribution.** China: Yunnan Province (Xishuangbanna).

***Dryocosmus caputgrusi* Tang & Schwéger, sp. n.**

<http://zoobank.org/BE520902-9F48-41F3-97DC-0152ADEB90E9>

Figures 18–32

**Type material.** HOLOTYPE female: TAIWAN: Taoyuan Co., Xiaowulai, entrance of Mt. Beichatian Trail, Fushing Township, 20.V.2011 (TWT476), ex *Castanopsis uraiana*, 24°47'52.44"N, 121°25'12.71"E, 937m, ex crane head like leaf gall (TWT114), adult em. 23.V.2011, leg. Chang-Ti Tang. PARATYPES: 3 females: TAIWAN: Taoyuan Co., Xiaowulai, entrance of Mt. Beichatian Trail, Fushing Township, 20.V.2011 (TWT476), ex *Castanopsis uraiana*, 24°47'52.44"N, 121°25'12.71"E, 937m, ex crane head like leaf gall, dissected on 20.V.2011, leg. Chang-Ti Tang; 1 female PARATYPE: TAIWAN: Taitung Co., Shanzhuku, Dawu Township, ex male catkin gall with long stalk on *Castanopsis carlesii* (TWTc1), 22°19'14.73"N, 120°51'39.03"E, 389 m, gall collected 30.III.2012 (TWT601), adult em. 13.IV.2012, leg. C.T. Tang, Y.K. Tzou.

The female holotype and 1 female paratype are deposited in NMNS, 1 female paratype in PHMB, 1 female paratype in NCHU.

**Etymology.** The Latin “caput” means “head”, and “*Grus*” is a common crane genus name. The name reflects the shape of the gall which looks like a crane head.

**Diagnosis.** *Dryocosmus caputgrusi*, *D. pentagonalis* and *D. triangularis* belong to the group of species in which striae marking the transepisternal line extend at least  $\frac{3}{4}$  of the mesopleuron length and the speculum is delicately striate (Fig. 24).

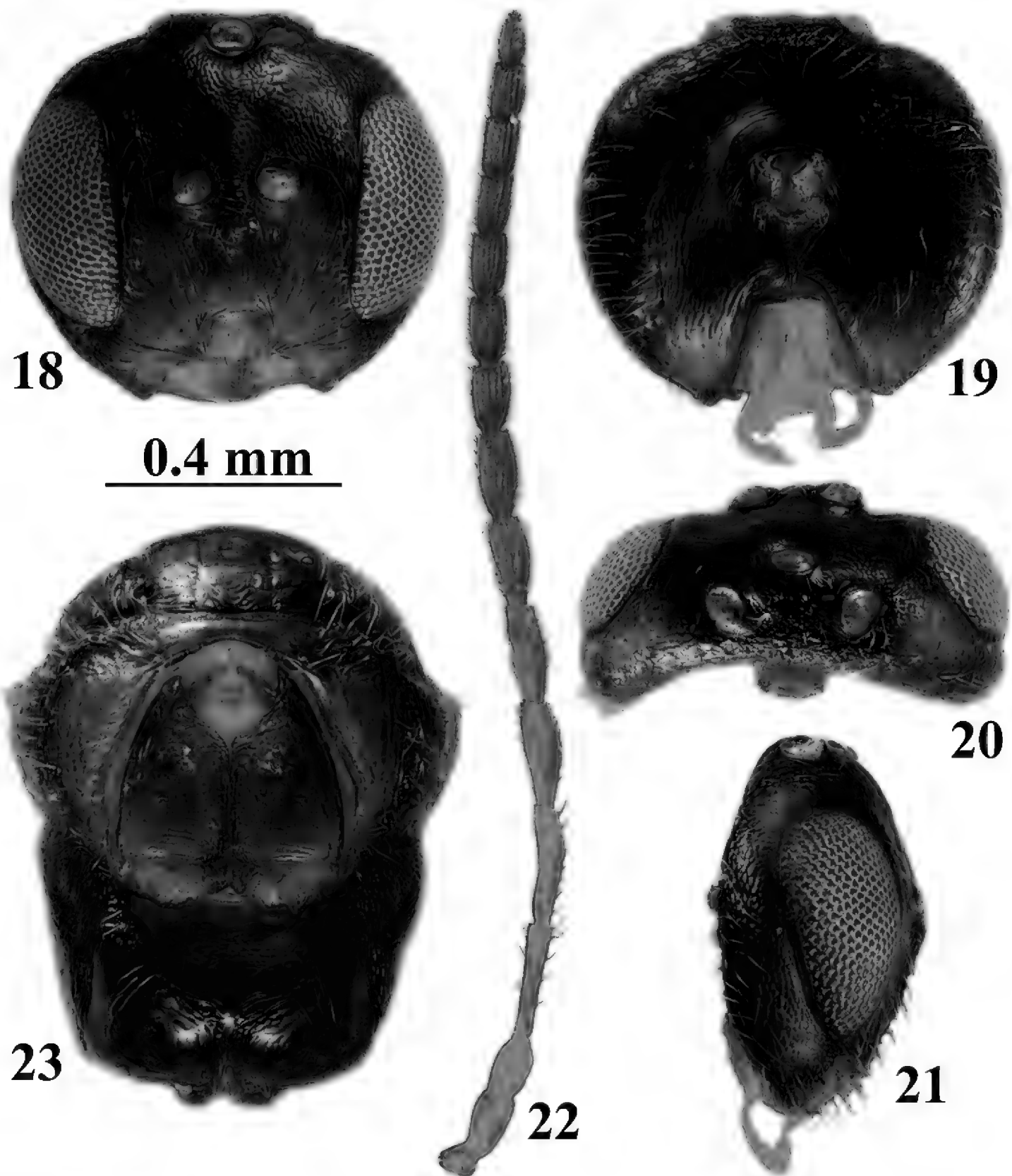
In *Dryocosmus triangularis* the female POL/OOL = 1.8 (Fig. 176); the male eye height / malar distance = 8.70; the male eye height / transfacial distance = 1.40 (Fig. 177); male pedicel nearly as long as the scape.

In *Dryocosmus caputgrusi* and *D. pentagonalis* the female POL/OOL = 1.4 (Figs 20, 174); male eye height / malar distance = 8.1; male eye height / transfacial distance = 1.20 (Fig. 175); the male pedicel / scape < 1.

*Dryocosmus caputgrusi*: the disc of the mesoscutellum is glabrous, smooth, at least in anterior half (Fig. 25).

*Dryocosmus pentagonalis*: the disc of the mesoscutellum is entirely rugose, matt (Fig. 178).

**Description.** Sexual female: Head color: brown; mandibles, maxillary and labial palps yellowish; scape and pedicel yellow, flagellomeres progressively darker. Mesosoma and metasoma color: dark brown, except for lighter tegula, propodeum and posterior half of metasoma, legs yellowish.



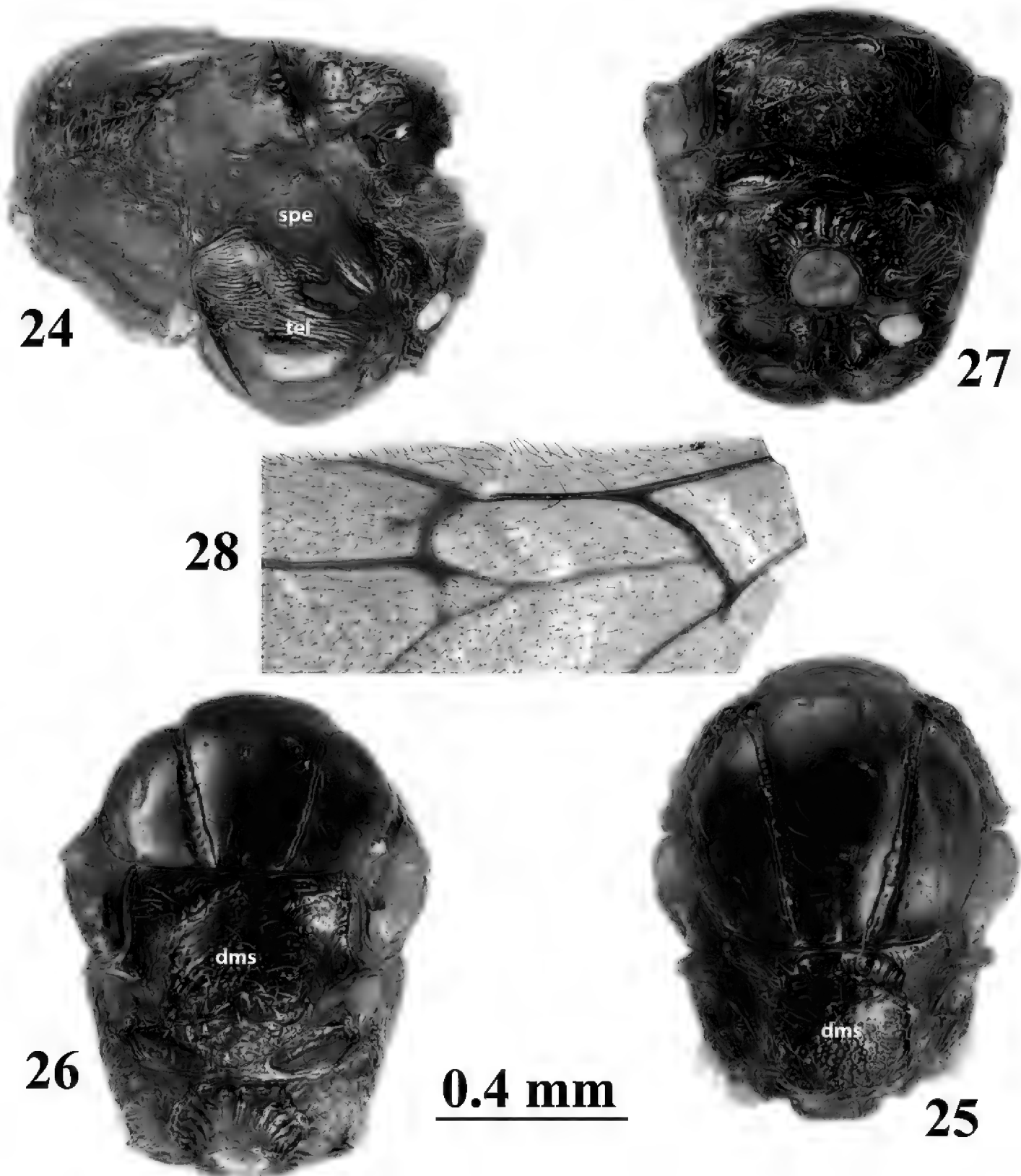
**Figures 18–23.** *Dryocosmus caputgrusi*, female, sp. n. 18–21, head: **18** frontal view **19** posterior view **20** dorsal view **21** lateral view **22** antenna **23** pronotum and propleuron, frontal view.

Head sculpture: coriaceous. Head shape anterior view: NOT CODED. Head width / head length: 2.10. Head width / head height: 1.10. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: matt. Gena length / eye width: 0.40. Gena shape: not broadened posterior to eye, not visible in frontal view. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar striae count: present. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.85. Inner margins of eyes: converging ventrally. Median



ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.40. OOL / diameter of lateral ocellus: 1.40. OOL / LOL: 1.45. Diameter of lateral ocellus / diameter of median ocellus: >1. Transfacial distance / eye height: 1.10. Diameter of torulus / intertorular distance: 1.10. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.25. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: rare. Clypeus convexity: convex. Clypeus sculpture: coriaceous. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: trapezoid. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: coriaceous. Frons pilosity density: rare. Frons reflectivity: matt. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: matt. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: matt. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: matt. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous with some sub-parallel delicate longitudinal wrinkles. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 13. Antenna length / body length: <1. Pedicel length / pedicel width: 2.0. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: >1. F1 length / F2 length: 1. F1 length / pedicel length: 1.75. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11>F12. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: NOT CODED. F13 length / F12 length: 1. Placoid sensilla present on: F2–F13.

Mesosoma length lateral view / mesosoma height lateral view: 1.15. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: foevolate. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1.07. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED.

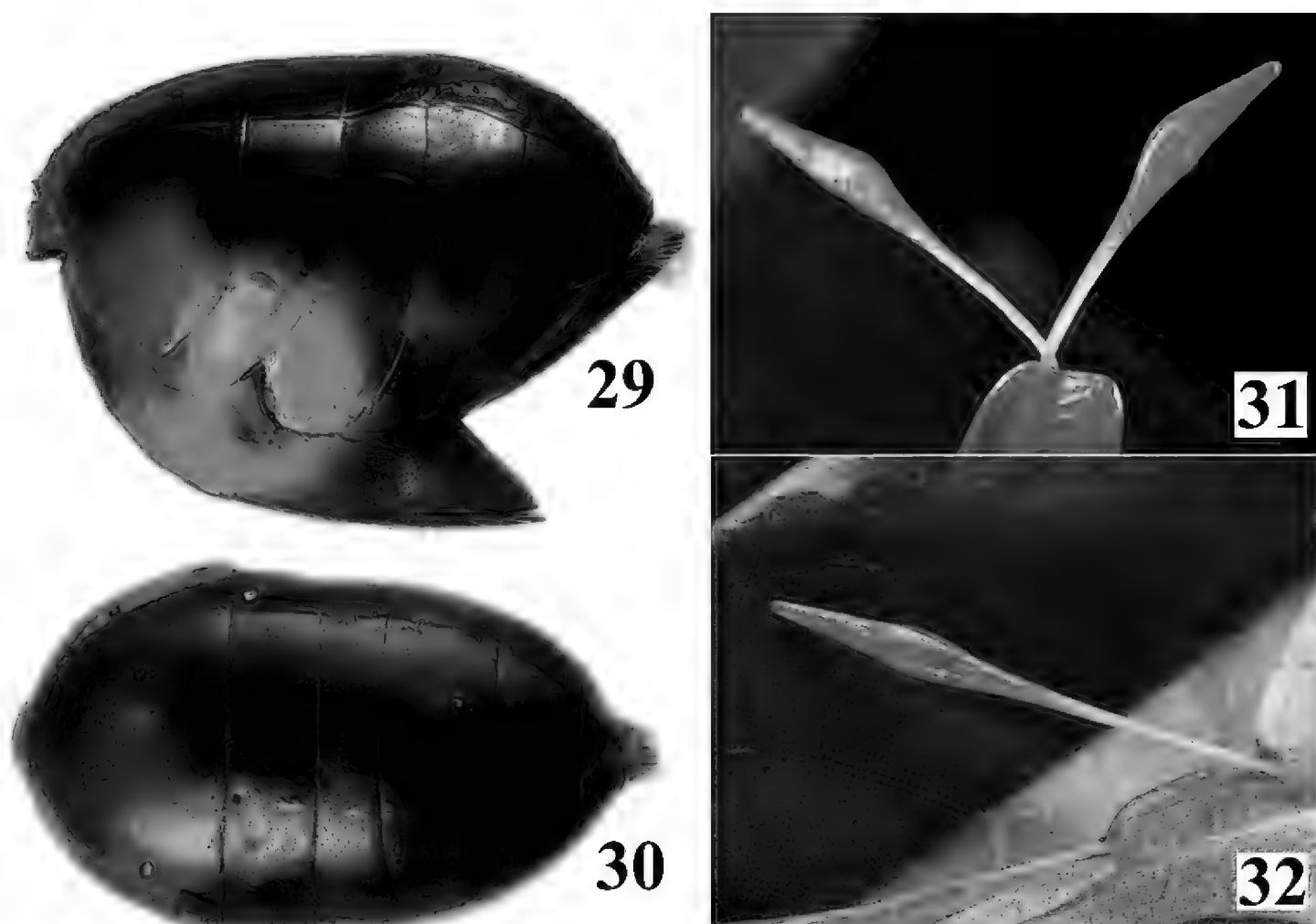


**Figures 24–28.** *Dryocosmus caputgrusi*, female, sp. n. **24** mesosoma, lateral view **25** mesosoma, dorsal view **26** mesosoma and propodeum, posterodorsal view **27** metascutellum and propodeum, posterodorsal view **28** fore wing, part (tel=transepisternal line, dms=disc of mesoscutellum, spe=speculum).

Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: present. Antero-admedian line length / mesoscutum median length: 0.2. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): smooth anteromedially, ru-

gose posteromedially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: smooth anteriorly rugose posteriorly. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: semi-lunar. Scutellar fovea reflectivity: glossy. Foveal septum: narrow, triangular. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: NOT CODED. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular suclus count: NOT CODED. Mesopleuron sculpture: smooth striae corresponding to transepisternal line extending to mesocoxal foramen, area dorsal to transepisternal line transversely striate. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: alutaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture slightly dorsally of its mid-height. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: smooth with irregular rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: coriaceous with irregular rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.5. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma



**Figures 29–32.** *Dryocosmus caputgrusi*, sp. n. **29–30** female, metasoma: **29** lateral view **30** dorsal view **31–32** galls (photos by C.-T. Tang).

dorsal view: 1/3. Second metasomal tergite pilosity: NOT CODED. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: glossy. Second metasomal tergite pilosity density: NOT CODED. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.70. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.60 mm (n=2).

Male: unknown

Gall (Figs 31–32): The gall is unilocular, spindle-shaped and is attached with a long stalk to the leaf. The gall is 8.0–12.7 mm long, 1.5–1.8 mm wide (n=4), with a stalk varying in length from 6.4 mm to 8.1 mm. The swollen part of the spindle-shaped gall indicates the position of the larval chamber. The gall is green at both young and mature stages, with a smooth surface when growing and delicately rugose when mature. Galls were found also on male catkins (Fig. 32). In this case, the gall is greenish and pubescent. The main body of the gall is spindle-shaped with a stalk; the spindle-shaped part is 5.3–6.0 mm long, and 1.1–1.4 mm wide (n=5). The length of the stalk varies from 4.9 mm to 6.8 mm (n=5).

**Biology.** Although only females were collected, the emergence of adults in May and the female morphology suggest that this is a sexual generation. Galls appear on



young leaves of *Castanopsis uraiana* in March; adults emerged in late May. The catkin galls (TWTc1, TWT601) were found on *Castanopsis carlesii* in late March; adults emerged in the first half of April.

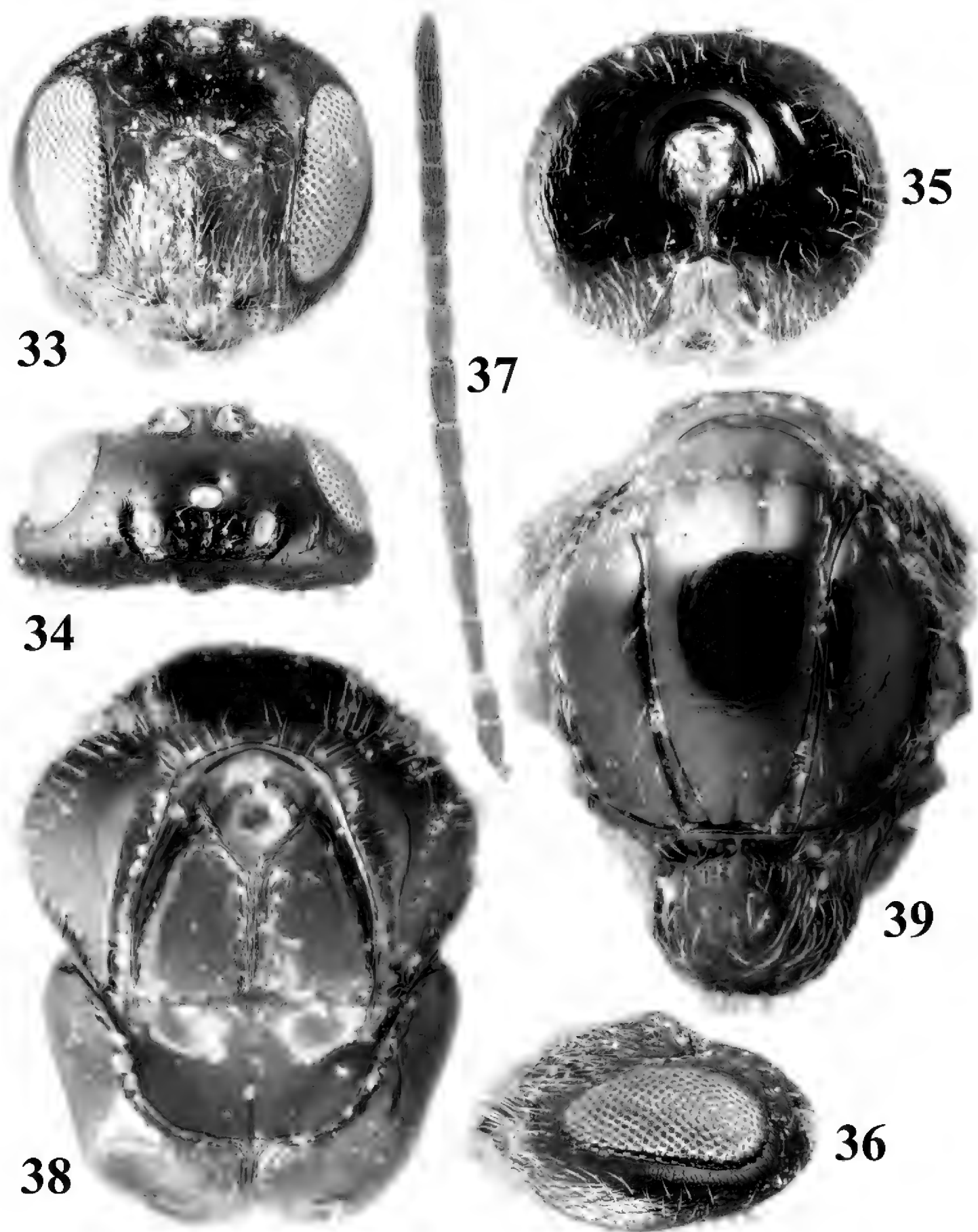
**Distribution.** Taiwan: Taoyuan and Taitung Counties.

***Dryocosmus crinitus* Schwéger & Tang, sp. n.**

<http://zoobank.org/EA49CB22-6819-4BA6-9134-E39C7BD63D3C>

Figures 33–47

**Type material.** HOLOTYPE female: TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 21.III.2012, leg. Chang-Ti Tang. Sixtynine female PARATYPES: 6 female paratypes with the same label as holotype; 6 female paratypes: TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 13.II.2012, leg. Chang-Ti Tang; 19 female paratypes: TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 16.III.2012, leg. Chang-Ti Tang; 4 female paratypes TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 20.III.2012, leg. Chang-Ti Tang; 5 female paratypes TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 30.III.2012, leg. Chang-Ti Tang; 3 female paratypes TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 7.IV.2012, leg. Chang-Ti Tang; 2 female paratypes TAIWAN: New Taipei City, Mt. Erge, Shihding Dist., ex clustered fluffy single-chambered leaf galls on *Quercus sessilifolia* (spTWl10), 24.967203°N, 121.619744°E, 678 m, gall collected 21.XI.2011 (TWT530), adult emerged 9.IV.2012, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex fluffy leaf galls on *Quercus morii* (spTWl10), 24.080803°N, 121.170517°E, 2217 m, gall collected 2.VI.2011 (TWT530), adult emerged 21.VI.2012, leg. Chang-Ti Tang; 2 female paratypes: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex fluffy leaf galls on *Quercus morii* (spTWl10), 24.080803°N, 121.170517°E, 2217 m, gall collected 2.VI.2011 (TWT530), adult emerged 26.VI.2012, leg. Chang-Ti Tang; 3 female paratypes: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex fluffy leaf galls on *Quercus morii* (spTWl10), 24.080803°N, 121.170517°E, 2217 m,



**Figures 33–39.** *Dryocosmus crinitus*, female, sp. n. **33–36** head: **33** frontal view **34** dorsal view **35** posterior view **36** lateral view **37** antenna **38** pronotum and propleuron, frontal view **39** mesosoma, dorsal view.

gall collected 2.VI.2011 (TWT530), adult emerged 2.VII.2012, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex fluffy leaf galls on *Quercus morii* (spTW110), 24.080803°N, 121.170517°E, 2217 m, gall collected 2.VI.2011 (TWT530), adult emerged 29.VI.2012, leg. Chang-Ti Tang;

1 female paratype: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex fluffy leaf galls on *Quercus morii* (spTW110), 24.080803°N, 121.170517°E, 2217 m, gall collected 2.VI.2011 (TWT530), adult emerged 18.VI.2012, leg. Chang-Ti Tang.

The female holotype, 20 female paratypes are deposited in NMNS, 20 female paratypes in PHMB, 10 female paratypes in USNM, and 19 female paratypes in NCHU.

**Etymology.** Named after the dense pilosity covering the gall surface. The Latin “*crinitus*” means “fluffy”.

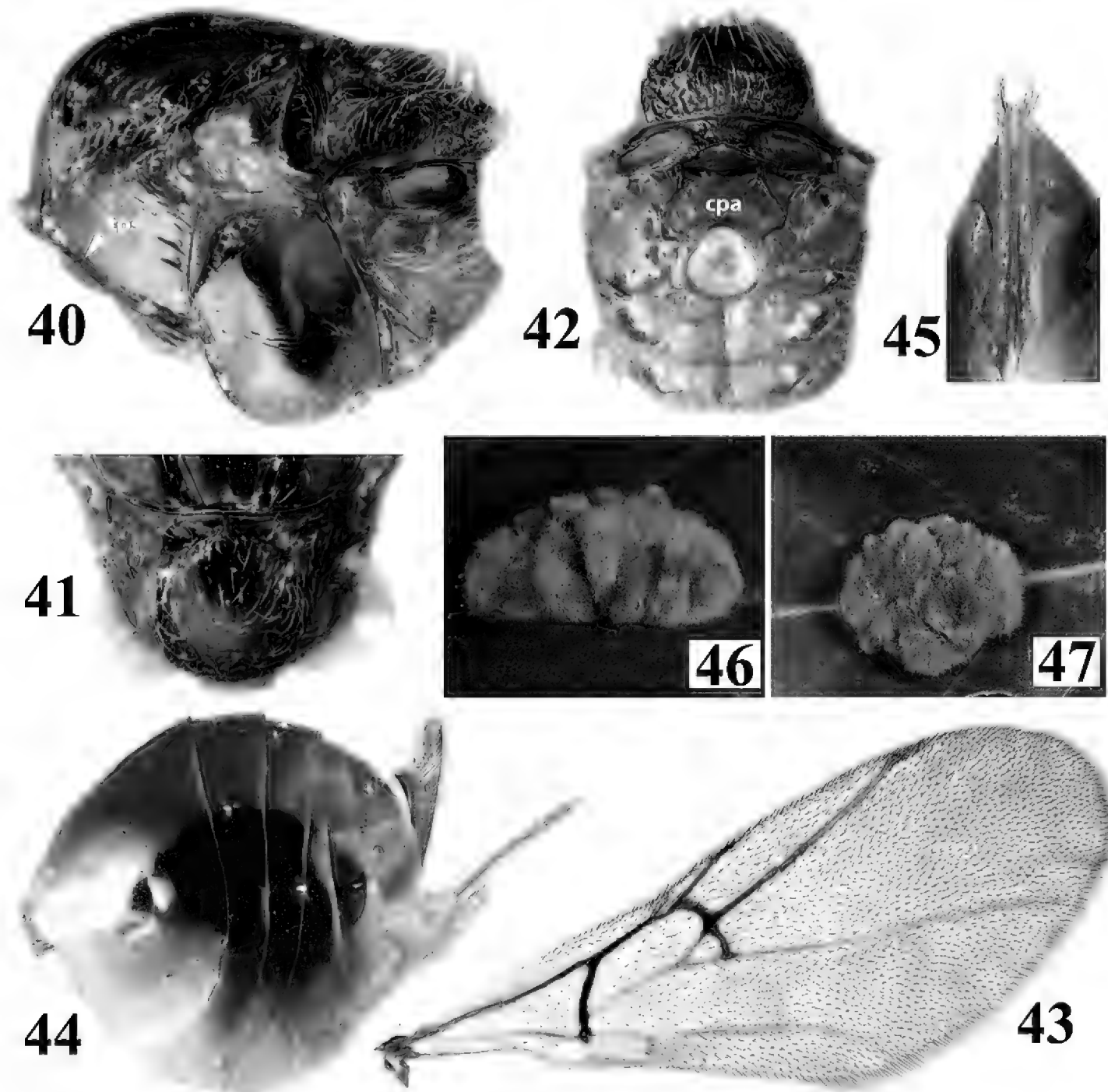
**Diagnosis.** *Dryocosmus crinitus*, *D. nanlingensis* and *D. liyingi* belong to the group of species in which the disc of the mesoscutellum lacks irregular rugae (Fig. 116), the scutellar fovea minimum diameter / foveal septum width = 6.0–10.0 and the anterior pits of foveal septum are absent (Fig. 116).

The central propodeal area has numerous distinct medial and lateral rugae in *Dryocosmus nanlingensis* and with 1–2 indistinct, delicate, longitudinal, lateral wrinkles in *D. crinitus* (Fig. 42). *Dryocosmus liyingi*: the transverse pronotal sulcus is foveolate; the pronotum posterolaterally has numerous long rugae which are 2–3 times as long as the diameter of the anterior thoracic spiracle (Fig. 113); the head is dark brown except yellowish brown malar region; the eye height / malar distance = 2.32; the transfacial distance / eye height = 1.44; the diameter of torulus / intertorular distance = 0.8 (Fig. 105); the POL/OOL = 1.06; the OOL / diameter of lateral ocellus = 2.1; the OOL / LOL = 2.05 (Fig. 106); the antenna is with 13 flagellomeres (Fig. 111).

*Dryocosmus crinitus*: the transverse pronotal sulcus is not foveolate; the pronotum posterolaterally has few short rugae as long as the diameter of the anterior thoracic spiracle (Fig. 40); the cranium is reddish brown anteriorly, dark brown dorsally and posteriorly, the eye height / malar distance = 4.54; the transfacial distance / eye height = 0.9; the diameter of torulus / intertorular distance = 1.8; the POL / OOL = 1.6; the OOL / diameter of lateral ocellus = 1.36; OOL / LOL = 1.36; the antenna is with 12 flagellomeres (Fig. 37).

**Description.** Asexual female: Head color: reddish brown, except for dark brown to black postgena, occiput, vertex; mandibles, maxillary and labial palps yellowish; scape, pedicel, F1 and F2 yellow, subsequent flagellomeres progressively darker. Mesosoma and metasoma color: black or dark brown, except for lighter tegula, propodeum, propleuron and mesopleuron, legs yellowish.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 1.90. Head width / head height: 1.20. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.50. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar striae count: present. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 4.54. Inner margins of eyes: converging ventrally. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.60. OOL / diameter of lateral ocellus: 1.36. OOL / LOL: 1.36. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 0.90. Diameter of torulus / intertorular distance: 1.80. Intertorular distance / eye torulus distance:



**Figures 40–47.** *Dryocosmus crinitus*, female, sp. n. **40** mesosoma, lateral view **41** mesoscutellum, dorsal view **42** metascutellum and propodeum, posterior view **43** fore wing **44** metasoma, lateral view **45** ventral spine of hypopygium, ventral view **46–47** galls (photos by C.-T. Tang) (tps=transverse pronotal sulcus, cpa=central propodeal area).

NOT CODED. Eye-torulus distance / diameter of torulus: 1.08. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: rare. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: NOT CODED. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: smooth. Frons pilosity density: NOT CODED. Frons reflectivity: glossy. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: glossy. Interocellar

area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: glossy. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: glossy. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: glossy. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: coriaceous. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen:  $<1$ . Postgenal bridge / length of oral foramen:  $<1$ . Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length:  $<1$ . Pedicel length / pedicel width: 1.60. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 0.8. F1 length / pedicel length: 1.4. F1 length / F3 length: NOT CODED. Flagellomeres relative length:  $F3 > F4 > F5 > F6 > F7 > F8 > F9 > F10 > F11$ . F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: 1.9. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F2–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.1. Pronotum sculpture: alutaceous medially, smooth laterally, with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: smooth. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1.1. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: present. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): coriaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width:  $>1$ . Disc of mesoscutellum sculpture: smooth. Disc of mesoscutellum maximum width: in posterior  $1/3$ . Scutellar fovea sculpture: smooth without longitudinal rugae. Scutel-



lar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: absent. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 2.5. Scutellar fovea minimum diameter / foveal septum width: 6–10. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: smooth, transepisternal line is marked by few delicate sulci, area dorsal to transepisternal line smooth. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: smooth. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: smooth with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: smooth with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 0.5. Metapleural sulcus anterior end: reaches mesometapleural suture slightly dorsally of its mid-height. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: smooth with 1–2 delicate longitudinal lateral rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: smooth. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 5.3. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/2. Second metasomal tergite pilosity: NOT CODED. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: glossy. Second metasomal tergite pilosity density: NOT CODED. Metasomal tergites 3–6 sculpture: smooth, micropunctate. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.20. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 1.80–2.10 mm (n=10).

Gall (Figs 46–47): The multilocular gall comprises 3–20 gall chambers in one cluster (n = 20). Each larval chamber is ovate at the base. The gall is attached to the leaf

midrib by a short stalk. A tuft of dense, dark brown hairs covers the larval cells. The gall is 10.7–15.5 mm long, and 8.1–13.3 mm wide (n=6).

**Biology.** The gall matures in late autumn, when the larval chambers drop off from the galls and the larvae overwinter in the leaf litter; adults emerge in the next spring suggesting that the asexual generation is described here. The sexual generation remains unknown. This species induces galls on *Quercus morii* and *Q. sessilifolia*.

**Distribution.** Taiwan: Renai Township, Nantou County; Jianshih Township, Hinchu County; Shishding Township, New Taipei City; Datung Township, Ilan County.

***Dryocosmus harrisonae* Melika & Tang, sp. n.**

<http://zoobank.org/796EC89B-9267-464E-B2B3-C888AEC76CFC>

Figures 48–63

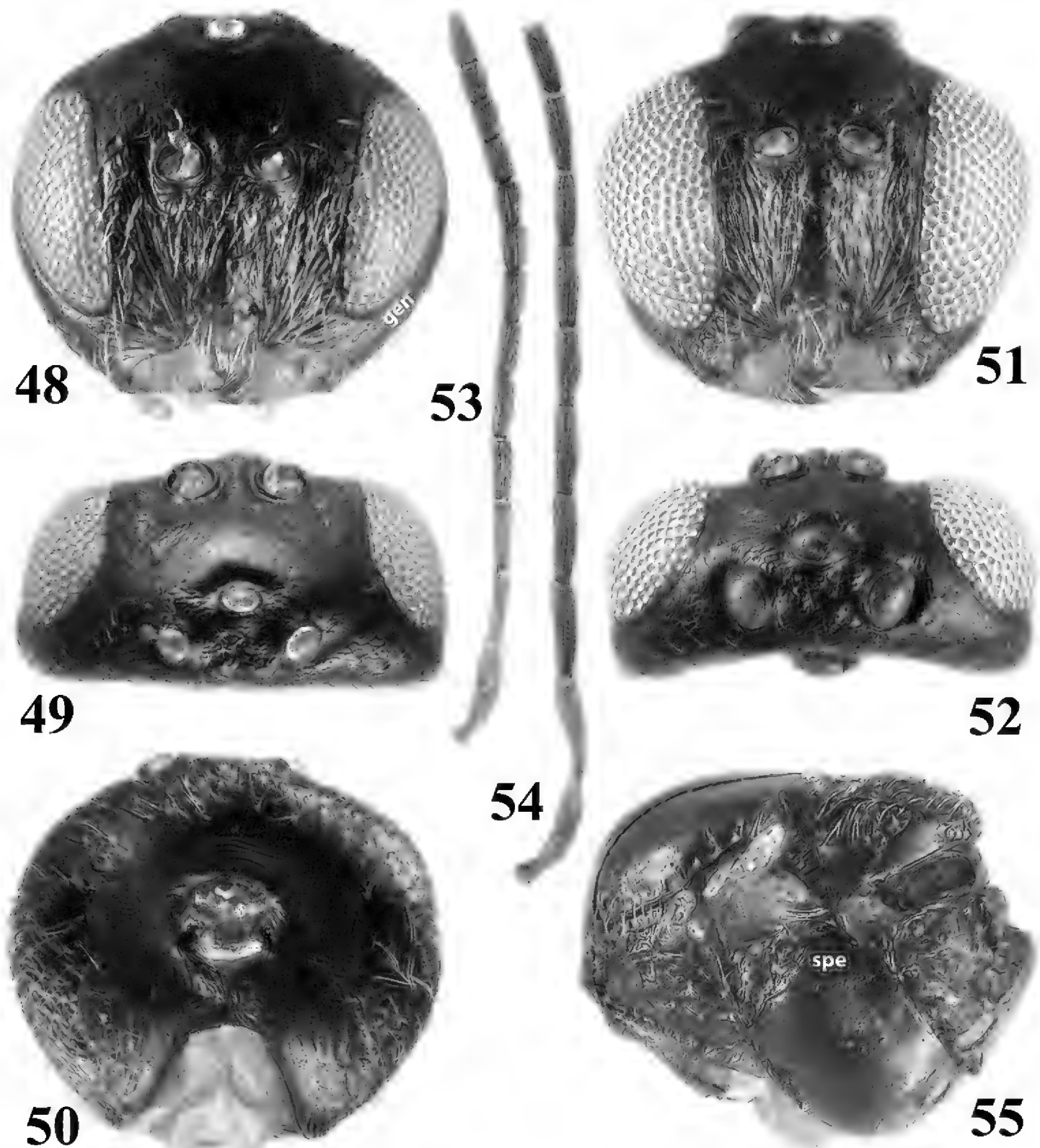
**Type material.** HOLOTYPE female: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI11), 21.968800°N, 100.600883°E, 1342m, ex oval chamber gall on stalk extending from petiole or midrib of very young leaf (AGWP-Morpho57), em. 13.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn. Four female and two male PARATYPES: 2 female paratypes: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI11), 21.968800°N, 100.600883°E, 1342m, ex oval chamber gall on stalk extending from petiole or midrib of very young leaf (AGWP-Morpho57), em. 17.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 2 female paratypes: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI11), 21.968800°N, 100.600883°E, 1342m, ex oval chamber gall on stalk extending from petiole or midrib of very young leaf (AGWP-Morpho57), em. 19.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 1 male paratype: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI11), 21.968800°N, 100.600883°E, 1342m, ex oval chamber gall on stalk extending from petiole or midrib of very young leaf (AGWP-Morpho57), em. 15.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 1 male paratype: CHINA: Yunnan Prov., Xishuangbanna, tea plantation near Meng Hai, ex *Castanopsis echinocarpa*, 7.IV.2011 (CHI11), 21.968800°N, 100.600883°E, 1342m, ex oval chamber gall on stalk extending from petiole or midrib of very young leaf (AGWP-Morpho57), em. 18.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn.

The female holotype and 1 male paratype are deposited in NMNS, 2 females and 1 male paratypes in PHMB, and 2 female paratypes in NCHU.

**Etymology.** Named in honour of Ms Warin Harrison (Xishuangbanna Tropical Botanical Garden, Yunnan, China), who was our guide during the collecting trip in China in 2011.

**Diagnosis.** See the diagnosis for *Dryocosmus cannoni*.

**Description.** Sexual female: Head color: dark brown, except for lighter clypeus; mandibles, maxillary and labial palps yellowish; scape and pedicel yellow, flagellomeres



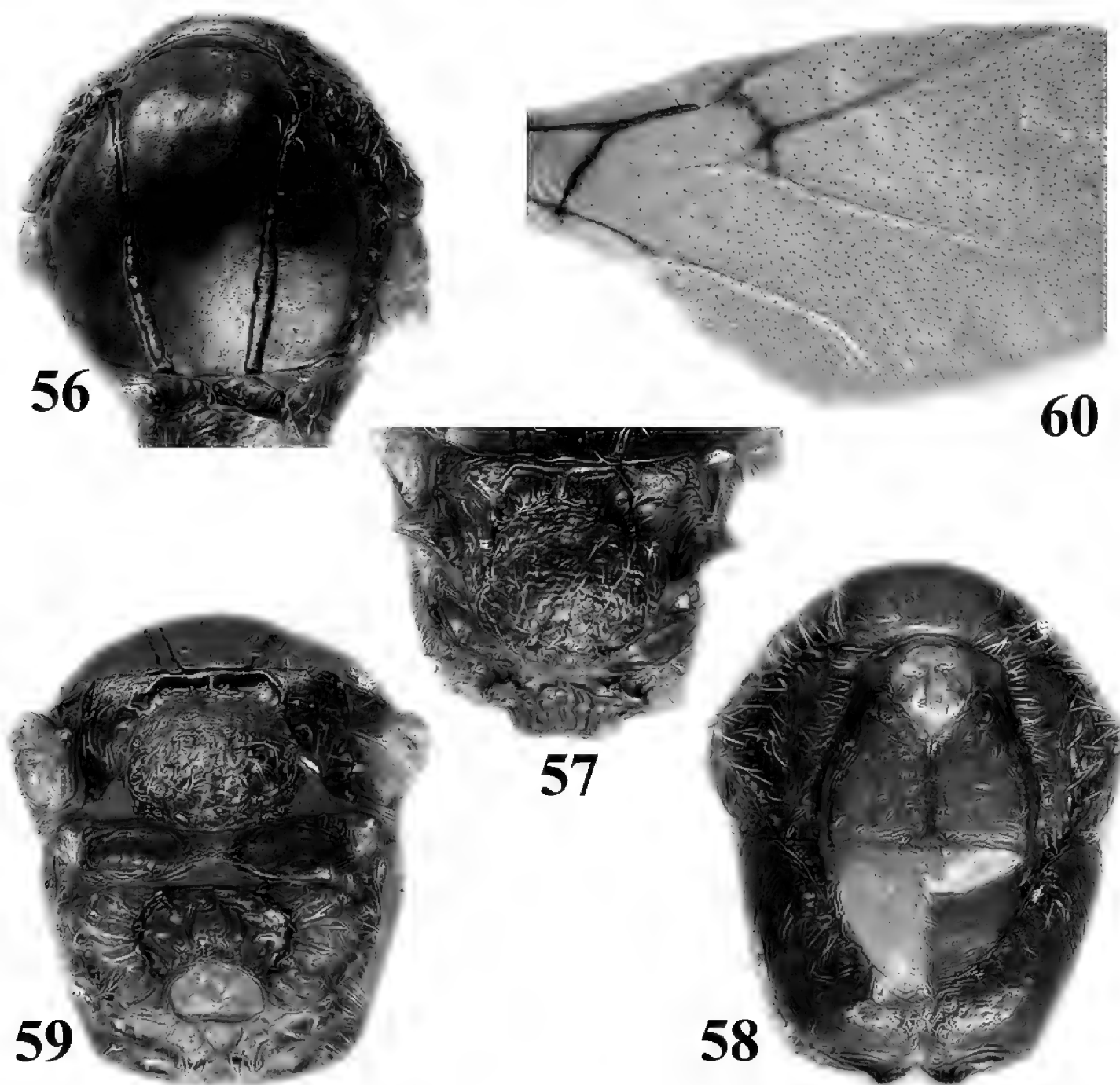
**Figures 48–55.** *Dryocosmus harrisonae* sp. n. **48–50** head, female: **48** frontal view **49** dorsal view **50** posterior view **51–52** head, male: **51** frontal view **52** dorsal view **53–54** antenna: **53** female **54** male **55** mesosoma, female, lateral view (gen=gena, spe=speculum).

progressively darker. Mesosoma and metasoma color: dark brown, except for lighter tegula and propodeum, legs yellowish.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 1.86. Head width / head height: 1.10. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.40. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on

malar area. Malar striae count: present. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 3.33. Inner margins of eyes: converging ventrally. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.10. OOL / diameter of lateral ocellus: 2.30. OOL / LOL: 1.70. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.16. Diameter of torulus / intertorular distance: 1.20. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.25. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: rare. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: indistinct. Clypeo-pleurostomal line: indistinct. Frons sculpture: coriaceous. Frons pilosity density: rare. Frons reflectivity: matt. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: matt. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: matt. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: matt. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous in outer area, smooth in inner area. Postgena reflectivity: glossy medially. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: 1.70. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1.16. F1 length / pedicel length: 1.9. F1 length / F3 length: NOT CODED. Flagellomeres relative length:  $F3 > F4 > F5 > F6 > F7 > F8 > F9 > F10 > F11$ .  $F4-F7$  relative length: NOT CODED.  $F3$  length/ $F2$  length: NOT CODED.  $F3$  length /  $F4$  length: NOT CODED.  $F8$  length /  $F7$  length: NOT CODED.  $F9$  length /  $F8$  length: NOT CODED.  $F10$  length /  $F9$  length: NOT CODED.  $F9-F11$  relative length: NOT CODED.  $F10$  length /  $F11$  length: NOT CODED.  $F12$  length /  $F11$  length: 1.5.  $F13$  length /  $F12$  length: NOT CODED. Placoid sensilla present on:  $F2-F12$ .

Mesosoma length lateral view / mesosoma height lateral view: 1.03. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: NOT CODED. Notaulus lim-



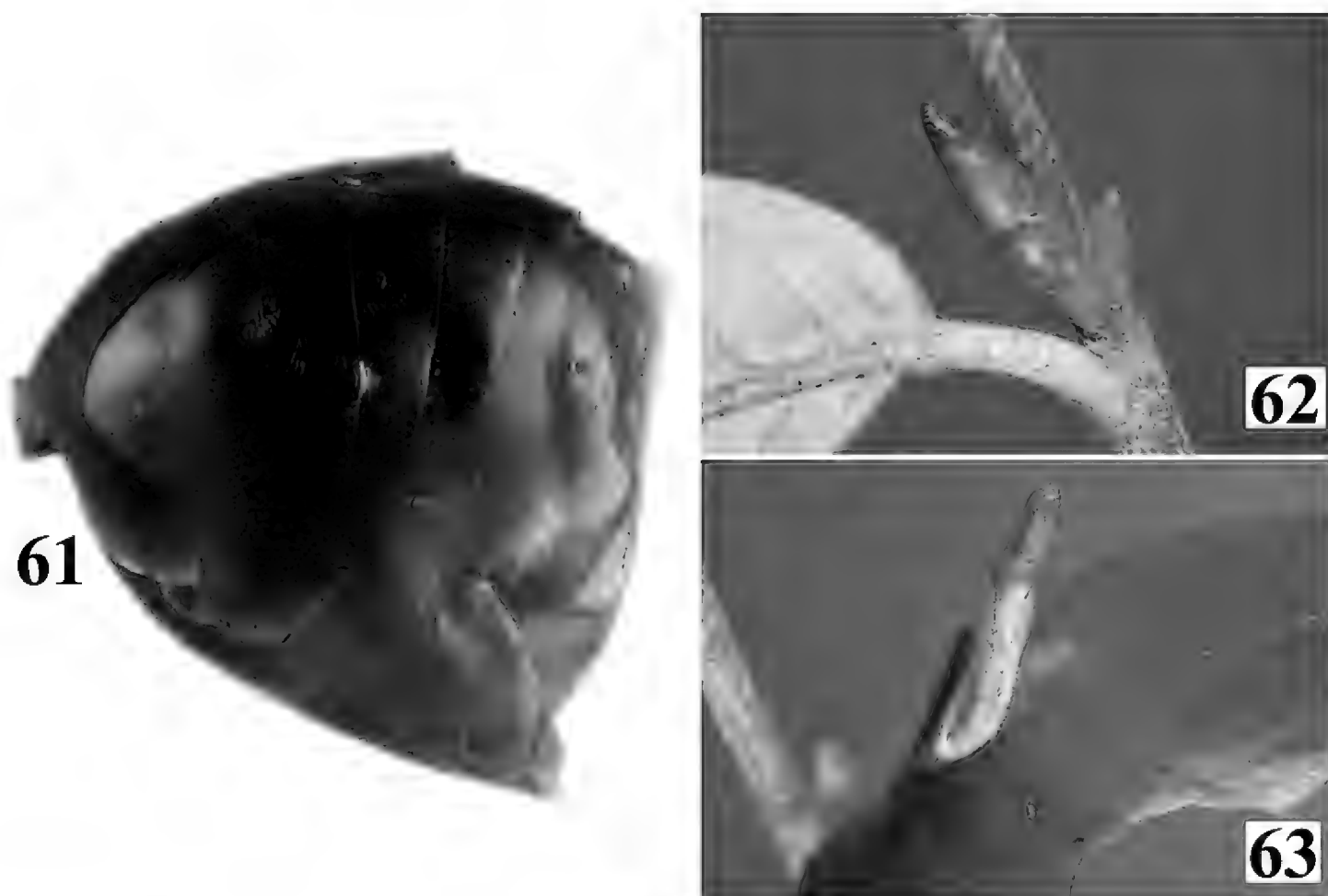
**Figures 56–60.** *Dryocosmus harrisonae*, female sp. n. **56** mesoscutum, dorsal view **57** mesoscutellum, dorsal view **58** pronotum and propleuron, frontal view **59** metascutellum and propodeum, posterodorsal view **60** fore wing, part.

its: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: present. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): coriaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of



mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width:  $>1$ . Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior  $1/3$ . Scutellar fovea sculpture: smooth without longitudinal rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 1.7. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular suclus count: NOT CODED. Mesopleuron sculpture: smooth transepisternal line is marked by few delicate sulci, area dorsal to transepisternal line smooth except few short transverse anterior striae. Mesopleuron reflectivity: matt; glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: wrinkled. Speculum reflectivity: NOT CODED. Mesopleural triangle sculpture: smooth. Mesopleural triangle reflectivity: glossy. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: NOT CODED. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1.25. Metapleural sulcus anterior end: reaches mesometapleural suture in upper  $1/3$  of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: smooth with irregular rugae. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: smooth with irregular rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.1. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length:  $<1$ . Metasoma lateral height / metasoma lateral length:  $<1$ . 2nd metasomal tergite length dorsal view / length of metasoma dorsal view:  $1/3$ . Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy.



**Figures 61–63.** *Dryocosmus harrisonae* sp. n. **61** female, metasoma, lateral view **62–63** galls (photos by C.-T. Tang).

Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.16. Hypopygial setae apical end: not extending beyond posterior end of ventral spine of hypopygium.

Body length: 1.90–2.10 mm (n = 3).

Male: Similar to female. Color: Head, mesosoma and metasoma dark brown; antenna brown. Eye size vs female eye size: Eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of torulus / intertorular distance: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus: 1.76. Flagellomeres count: 13. Antenna length / body length: 1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 1.07. Flagellomeres relative length:  $F2 > F3 > F4 > F5 > F6 > F9 > F10 > F11 > F12$ . F13 length / F12 length:  $>1$ . Placoid sensilla present on: F2–F13. Body length: 1.9 mm (n=1).

Gall (Figs 62–63): Galls are located on axillary buds or young leaves on young shoots. The cross-section of the gall is triangular, with a short stalk connected to the host-plant. The gall is greenish, with a brownish tip and a greenish-brown central region, 3.9–4.6 mm long and 1.7–2.0 mm broad (n=2).

**Biology.** Only the sexual generation is known. Galls are on young shoots of *Castanopsis echinocarpa*. Galls were collected in April; adults emerged from galls under laboratory conditions immediately after field collection.

**Distribution.** China: Yunnan Province.

***Dryocosmus hearni* Melika & Tang, sp. n.**

<http://zoobank.org/3E8127B2-15D1-4180-A727-E63DCA523064>

Figures 64–76

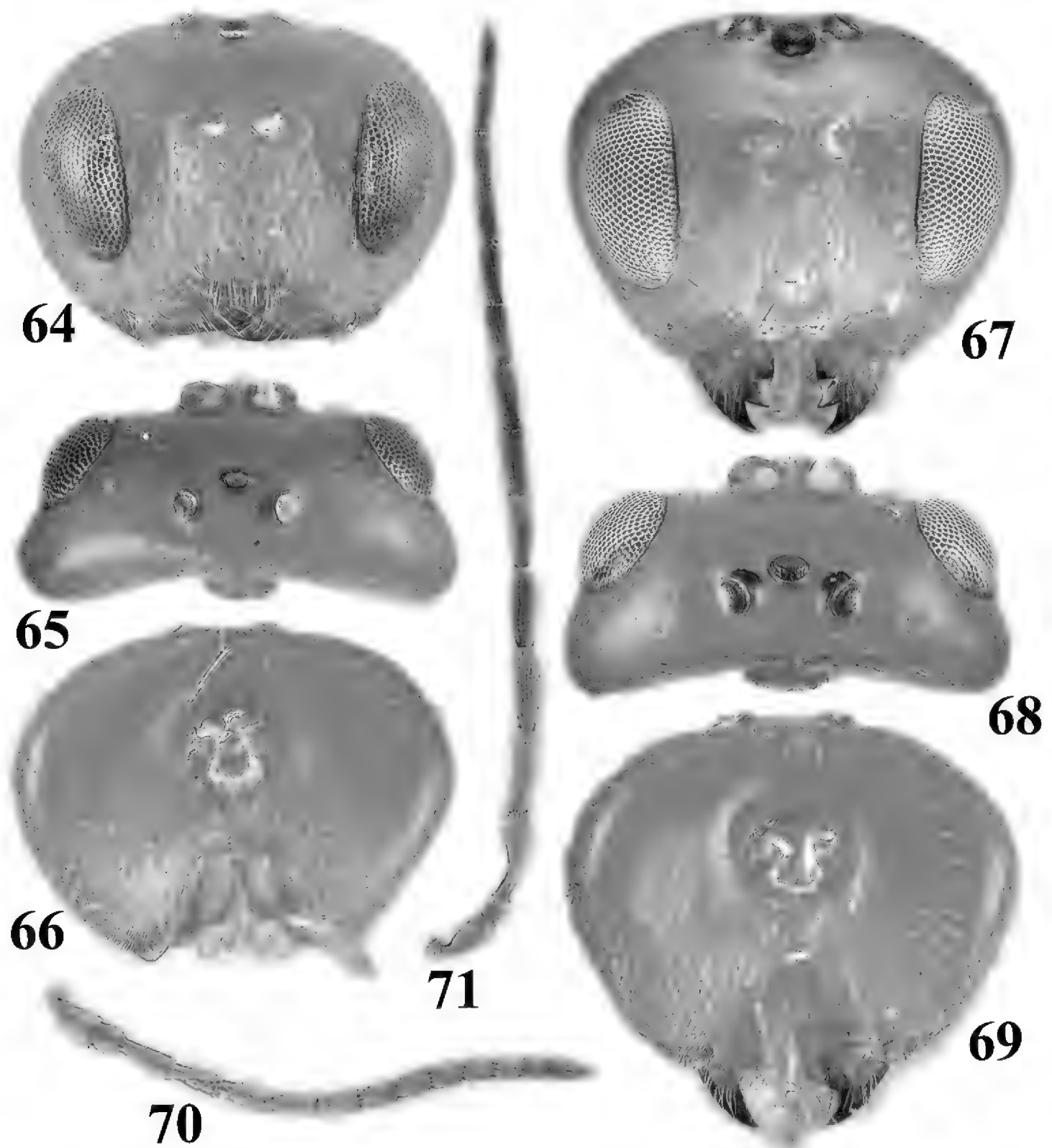
**Type material.** HOLOTYPE female: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi ex *Castanopsis* sp4, 11.IV.2011 (CHI48), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 13.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn. Fifteen female and twenty seven male PARATYPES: 5 female and 7 male paratypes with the same labels as holotype; 2 female and 7 male paratypes: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI48), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 14.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 4 female and 4 male paratypes: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI48), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 15.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 2 male paratypes: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI49), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 12.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 4 male paratypes: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI49), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 13.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 2 male paratypes: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI49), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 14.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 1 male paratype: CHINA: Yunnan Prov., Lan Cang Co., Xiagudi, ex *Castanopsis* sp4, 11.IV.2011 (CHI49), 22.630467°N, 100.026650°E, 1675m, ex integrated large leaf gall (AGWP-Morpho68), em. 15.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn; 4 female paratypes: CHINA: Yunnan Prov., Lan Cang Co., Mt. Xinghou 3, ex *Castanopsis* sp4, 12.IV.2011 (CHI55), 22.073200°N, 100.184450°E, 1329m, ex integrated large leaf gall (AGWP-Morpho68), em. 14.IV.2011, leg. C. T. Tang, F. Sinclair, J. Hearn.

The female holotype, 4 female and 7 male paratypes are deposited in NMNS, 5 female and 7 male paratypes in PHMB, 2 female and 4 male paratypes in USNM, 4 female and 9 male paratypes in NCHU.

**Etymology.** Named in honour of Dr. Jack Hearn (Institute of Evolutionary Biology, University of Edinburgh, Scotland), whose help was crucial in the organization of the collecting trip to China in 2011.

**Diagnosis.** Most similar to *Dryocosmus testisimilis*.

*Dryocosmus hearni*: the head and mesosoma of females and males are orange-yellow (Figs 64–69, 72–73), the metasoma is dark brown. The notaulus posterior region width / anterior region width = 5 (Fig. 73); posterior height of subaxillular bar / height of metanotal trough = 0.25 (Fig. 72); the central propodeal area is with a transverse carina in dorsal 1/3rd (Fig. 74).



**Figures 64–71.** *Dryocosmus hearni* sp. n. **64–66** head, female: **64** frontal view **65** dorsal view **66** posterior view **67–69** head, male: **67** frontal view **68** dorsal view **69** posterior view **70–71** antenna: **70** female **71** male.

*Dryocosmus testisimilis*: in females the head and mesosoma are light brown, the mesoscutum, mesopleuron, metapleuron and propodeum are darker, the metasoma dark brown (Figs 180–181).

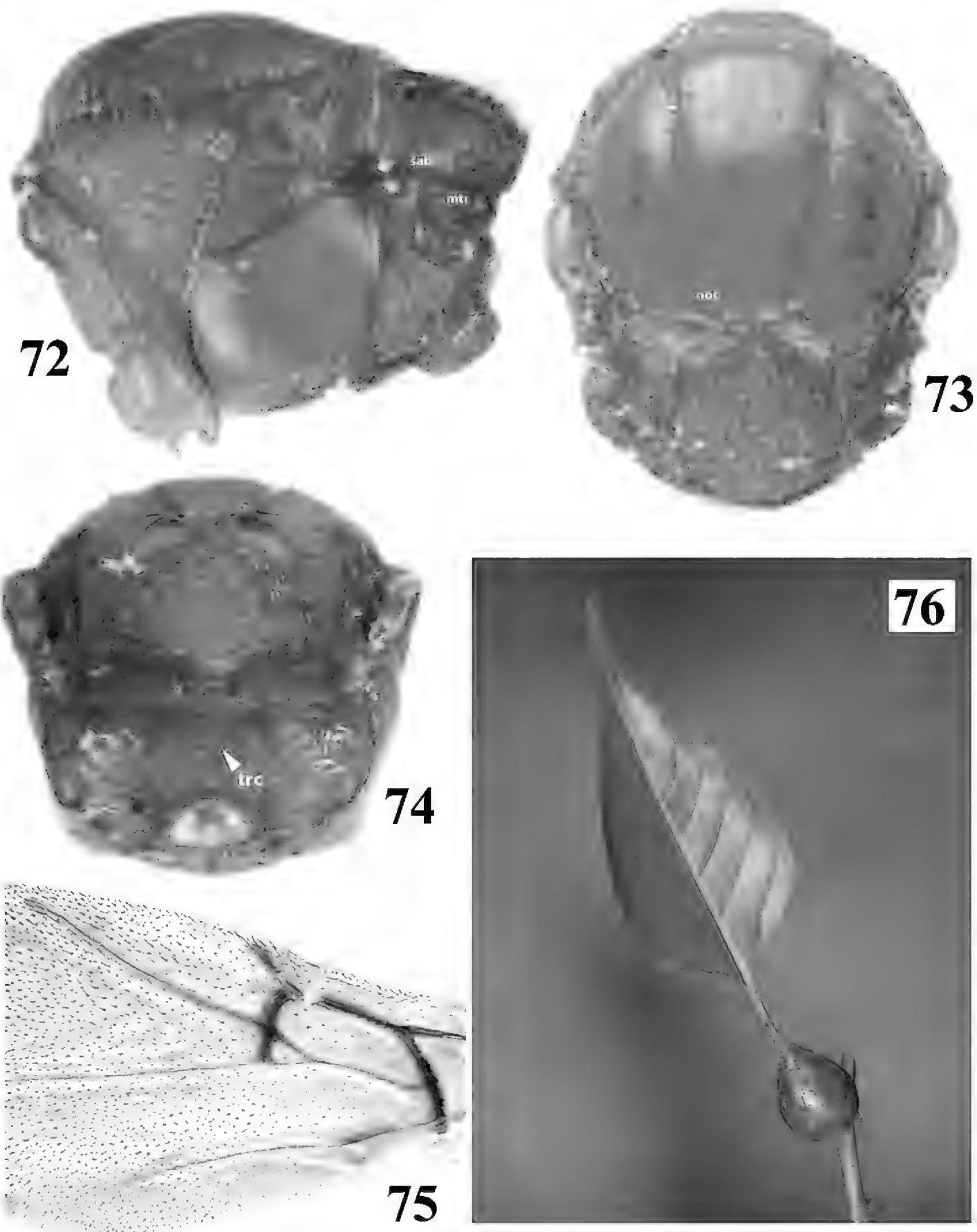
The body dark brown in males.

The notaulus posterior region width / anterior region width = 1 (Fig. 181), posterior height of subaxillular bar / height of metanotal trough > 1; the central propodeal area without a transverse carina in dorsal 1/3rd (Fig. 179).

**Description.** Sexual female: Head color: orange-yellow, except for darker mandibles, scape, pedicel, F1–F5 yellowish brown, subsequent flagellomeres progressively darker. Mesosoma and metasoma color: mesosoma orange-yellow, except for legs yellowish, except tibia and first tarsomere dark brown, metasoma dark brown.

Head sculpture: smooth, glossy. Head shape anterior view: NOT CODED. Head width / head length: 2.0. Head width / head height: 1.30. Head width / maximum mesosoma width: 1. Gena sculpture: smooth. Gena reflectivity: glossy. Gena length / eye width: 0.82. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.50. Inner margins of eyes: NOT CODED. Median ocellus shape: spherical. Lateral ocellus shape: ovate. POL / OOL: 0.84. OOL / diameter of lateral ocellus: 2.60. OOL / LOL: 3.10. Diameter of lateral ocellus / diameter of median ocellus: NOT CODED. Transfacial distance / eye height: 1.37. Diameter of torulus / intertorular distance: 2.00. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.40. Lower face sculpture: alutaceous. Lower face pilosity color: NOT CODED. Lower face pilosity density: dense. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: small, indistinct. Epistomal sulcus: indistinct. Clypeo-pleurostomal line: indistinct. Frons sculpture: smooth. Frons pilosity density: rare. Frons reflectivity: glossy. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: smooth. Interocellar area pilosity density: rare. Interocellar area reflectivity: glossy. Interocellar area pilosity color: white. Vertex sculpture: smooth. Vertex pilosity density: rare. Vertex reflectivity: glossy. Vertex pilosity color: white. Occiput sculpture: smooth. Occiput pilosity density: rare. Occiput reflectivity: glossy. Occiput pilosity color: white. Postocciput sculpture: smooth. Postocciput reflectivity: glossy. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: NOT CODED. Posterior tentorial pit: large, deep, distinct. Impression adjacent ventrally to posterior tentorial pit: absent. Postgena sculpture: smooth. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: present. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: <1.0. Pedicel length / length of broadened part of scape: 0.68. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1.1. F1 length / pedicel length: 1.7. F1 length / F3 length: 1.00. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: NOT COD-





**Figures 72–76.** *Dryocosmus hearni* sp. n. **72–75** female: **72** mesosoma, lateral view **73** mesosoma, dorsal view **74** metascutellum and propodeum, posterodorsal view **75** fore wing, part. **76** gall (photo by C.-T. Tang) (not=notaulus, trc=transverse carina on central propodeal area, sab=subaxillular bar, mtr=metanotal trough).

ED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: 1.63. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F2–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.26. Pronotum sculpture: smooth with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1.2. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: present. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): coriaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth without longitudinal rugae. Scutellar fovea shape: semilunar. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: NOT CODED. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: smooth, striae marking transepisternal line absent. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: rugose. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: white. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: smooth. Dorsoaxillar area reflectivity: glossy. Dorsoaxillar area pilosity color: white. Dorsoaxillar area pilosity density: rare. Lateroaxillar area sculpture: smooth. Lateroaxillar area reflectivity: glossy. Lateroaxillar area pilosity density: rare. Lateroaxillar area pilosity color: white. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 0.25. Metapleural sulcus anterior end: reaches mesometapleural suture in upper 1/3 of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: smooth, with transverse carina in dorsal 1/3rd and with longitudinal parallel rugae between transverse carina and

nucha. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high slightly curved laterally in mid-height. Lateral propodeal area sculpture: rugose. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: rare. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 3.7. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 0.40. Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.30. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.80–3.10mm (n = 5).

Male: Similar to female. Color: Head and mesosoma orange-yellow; metasoma dark brown; antenna light brown to dark brown; inner margins of lateral ocelli dark brown. Eye size vs female eye size: eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of torulus / intertorular distance: 3.0. Diameter of lateral ocellus vs diameter of female lateral ocellus: 1.30. Flagellomeres count: 13. Antenna length / body length: >1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 1.07. Flagellomeres relative length: F2>F3>F4>F5>F6>F9>F10>F11>F12. F13 length / F12 length: 1.08. Placoid sensilla present on: F2–F13. Body length: 2.7–2.9 mm (n=5).

Gall (Fig. 76): Galls are integrated leaf swellings, usually located at the base of leaves, and are concolorous with the leaves. The galls are 22.4–24.3 mm long, 18.2–19.0 mm wide (n=3).

**Biology.** Only the sexual generation is known. Galls were collected from young leaves of *Castanopsis* sp. in April and adults emerged from galls under laboratory conditions immediately after field collection.

**Distribution.** China: Yunnan Province

**Comments.** The pairwise genetic distances from other *Dryocosmus* species, based upon 433 base pairs of the cytochrome *b* gene (Table 1) and some morphological characters (the very broad notaulus in the posterior half, large scutellar foveae, the unique pattern of carinae on the central propodeal area, the uniformly orange-yellow body) make this species peculiar among all other Eastern Palearctic *Dryocosmus* species which are associated with *Cyclobalanopsis* or *Castanopsis*.

***Dryocosmus hualieni* Schwéger & Tang, sp. n.**

<http://zoobank.org/658C175E-8C34-44CA-B9C4-F3E6B07D3290>

Figures 77–90

**Type material.** Holotype female: TAIWAN, Hualien Co., 152K, Central-Cross Island Highway, Xiulin township, ex twig swellings on *Quercus glauca* (spTWs2); 24.204171N, 121.443636E, 1162m, gall collected 14.II.2012 (TWT546), adult emerged 1.V.2012, leg. Chang-Ti Tang. 6 female PARATYPES: TAIWAN, Hualien Co., 152K, Central-Cross Island Highway, Xiulin township, ex twig swellings on *Quercus glauca* (spTWs2); 24.204171N, 121.443636E, 1162m, gall collected 14.II.2012 (TWT546), adult cut out 28.IX.2012, leg. Chang-Ti Tang.

The holotype female, 2 female paratypes are deposited in NMNS, 2 female paratypes in PHMB, 1 female paratype in USNM and 1 female paratype in NCHU.

**Etymology.** Named after Hualien County, Taiwan where the species was collected.

**Diagnosis.** Asexual females of *Dryocosmus hualieni* resemble the asexual females of *D. taitungensis* and the sexual females of *D. konradi*. All three species are known from Taiwan only and are associated with *Cyclobalanopsis* species. *Dryocosmus hualieni* and *D. taitungensis* induce stem swelling-like galls, while *D. konradi* induces bud galls.

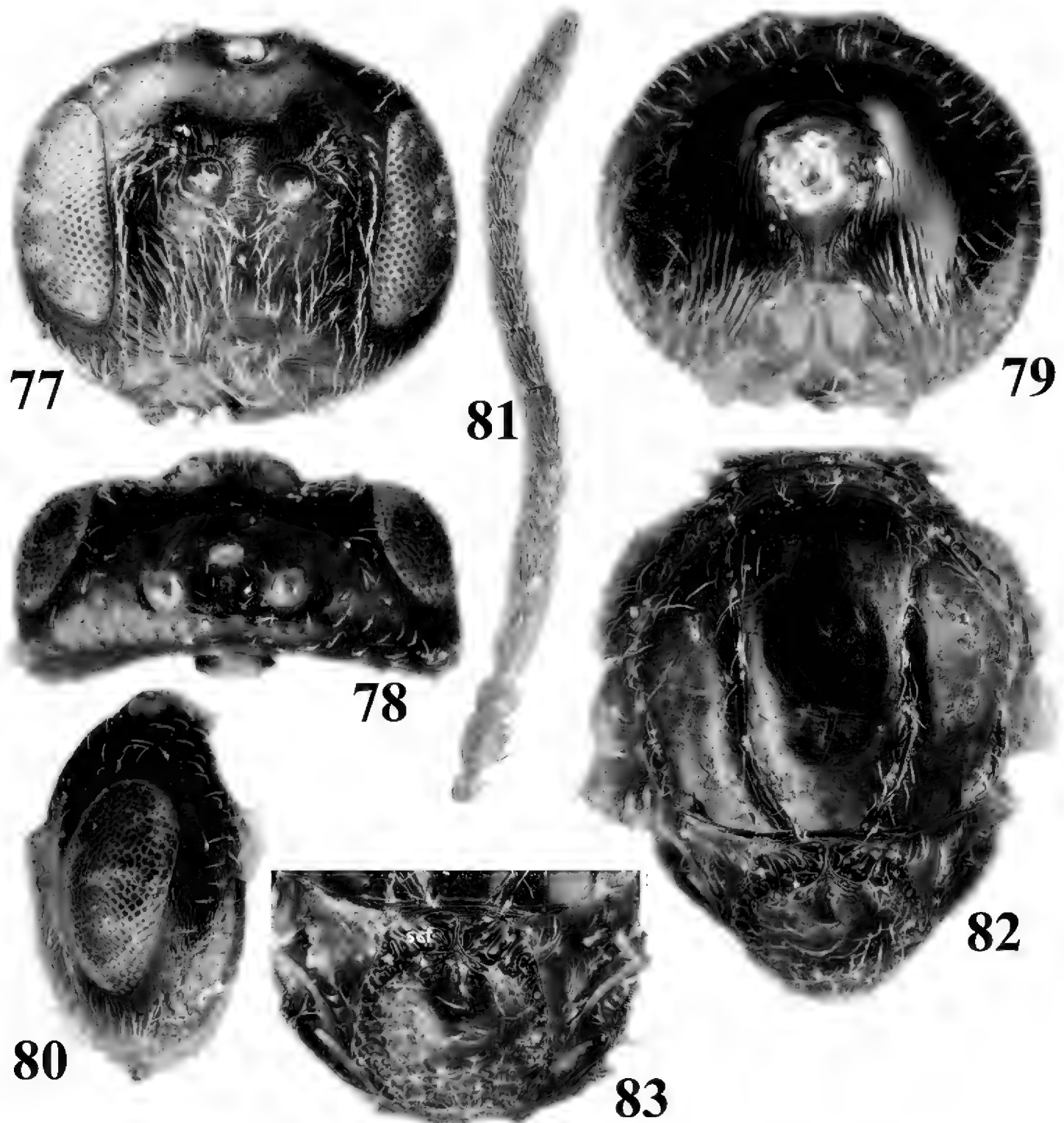
In *Dryocosmus hualieni* and *D. konradi* the second metasomal tergite has multiple setae laterally (Fig. 87), while in *D. taitungensis* the second metasomal tergite has only few setae laterally (Fig. 171). In *Dryocosmus konradi*: the bottom of scutellar foveae without rugae (Fig. 100); the female F1 / F2 = 1; female F1 / pedicel = 2.7; placoid sensilla are present on F1–F12 (Fig. 97).

*Dryocosmus hualieni*: the bottom of scutellar foveae with numerous longitudinal rugae (Fig. 83); female F1 / F2 < 1; the female F1 / pedicel = 1.6; placoid sensilla are present on F2–F12 (Fig. 81); the frons is alutaceous; the acetabular sulcus absent, the speculum is without striae (Fig. 84), the mesoscutellum rounded, anterior part without rugae, glabrous (Fig. 83).

*Dryocosmus taitungensis*: the frons is coriaceous, with numerous transverse striae above toruli; the acetabular carina present; the speculum with striae (Fig. 166); the mesoscutellum trapezoid, uniformly rugose, matt (Fig. 167).

**Description.** Asexual female: Head color: black, except lighter clypeus, central part of lower face and area around toruli; mandibles, maxillary and labial palps yellowish; scape and pedicel yellow, flagellomeres progressively darker. Mesosoma and metasoma color: dark brown to black, except for lighter tegula, propleuron, propodeum; legs yellowish.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 2.10. Head width / head height: 1.30. Head width / maximum mesosoma width: < 1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.50. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.77. Inner margins of eyes: converging ventrally. Median ocellus



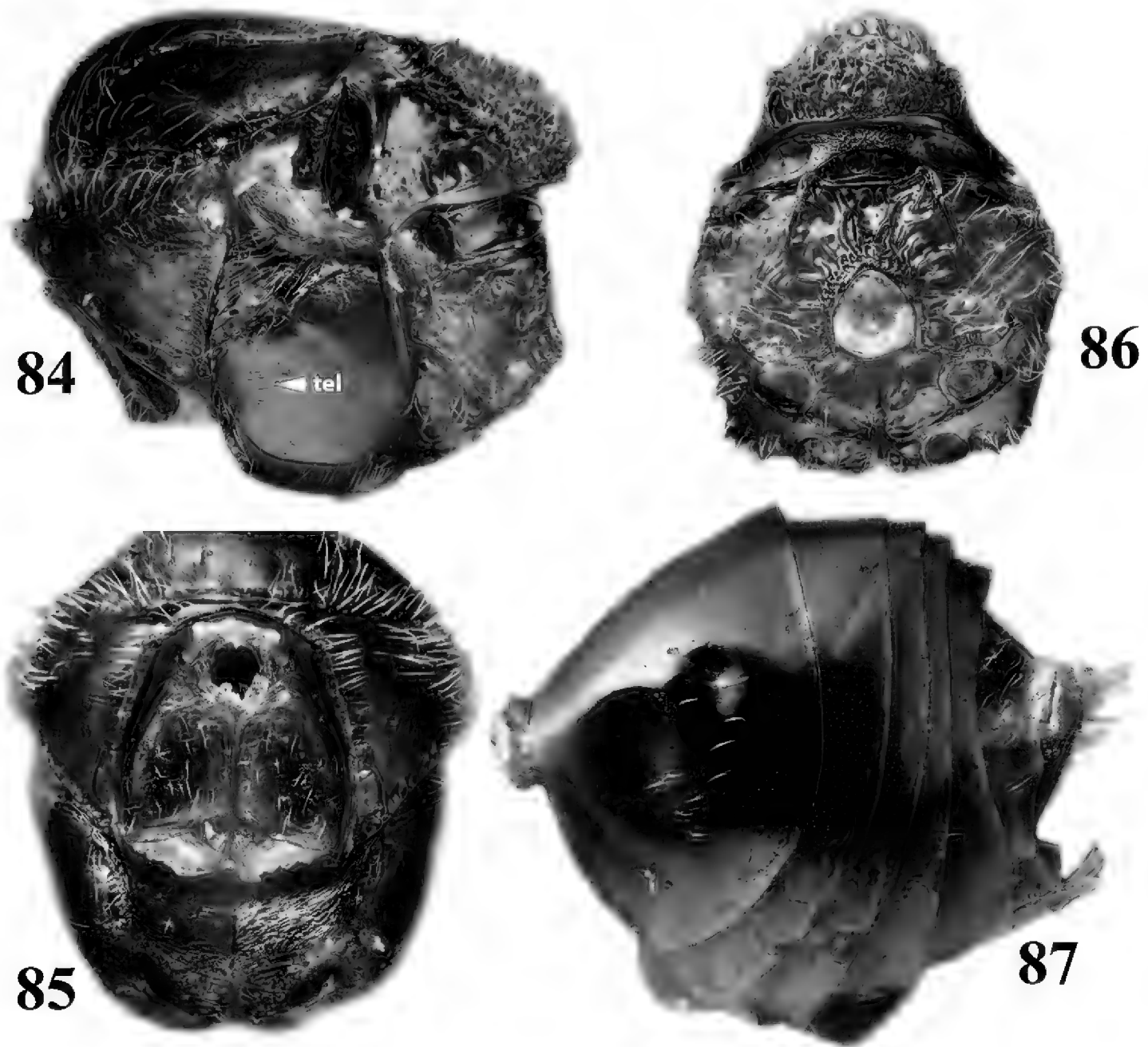
**Figures 77–83.** *Dryocosmus hualieni*, female, sp. n. **77–80** head: **77** frontal view **78** dorsal view **79** posterior view **80** lateral view. **81** antenna **82** mesosoma, dorsal view **83** mesoscutellum, dorsal view.

shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.05. OOL / diameter of lateral ocellus: 1.80. OOL / LOL: 1.90. Diameter of lateral ocellus / diameter of median ocellus: >1. Transfacial distance / eye height: 1.20. Diameter of torulus / intertorular distance: 1.40. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.50. Lower face sculpture: coriaceous. Lower face pilosity color: white. Lower face pilosity density: dense. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity



color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: alutaceous. Frons pilosity density: NOT CODED. Frons reflectivity: matt. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: NOT CODED. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: NOT CODED. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: NOT CODED. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous with some sub-parallel delicate longitudinal wrinkles. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: <1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: <1.0. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 0.75. F1 length / pedicel length: 1.6. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: 1.6. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F2–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.16. Pronotum sculpture: alutaceous medially, smooth laterally, with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: foveolate. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: 1.00. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): smooth anteromedially, rugose posteromedially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid.



**Figures 84–87.** *Dryocosmus hualieni*, female, sp. n. **84** mesosoma, lateral view **85** pronotum and propleuron, frontal view **86** metascutellum and propodeum, posterior view **87** metasoma, lateral view (tel=transepisternal line).

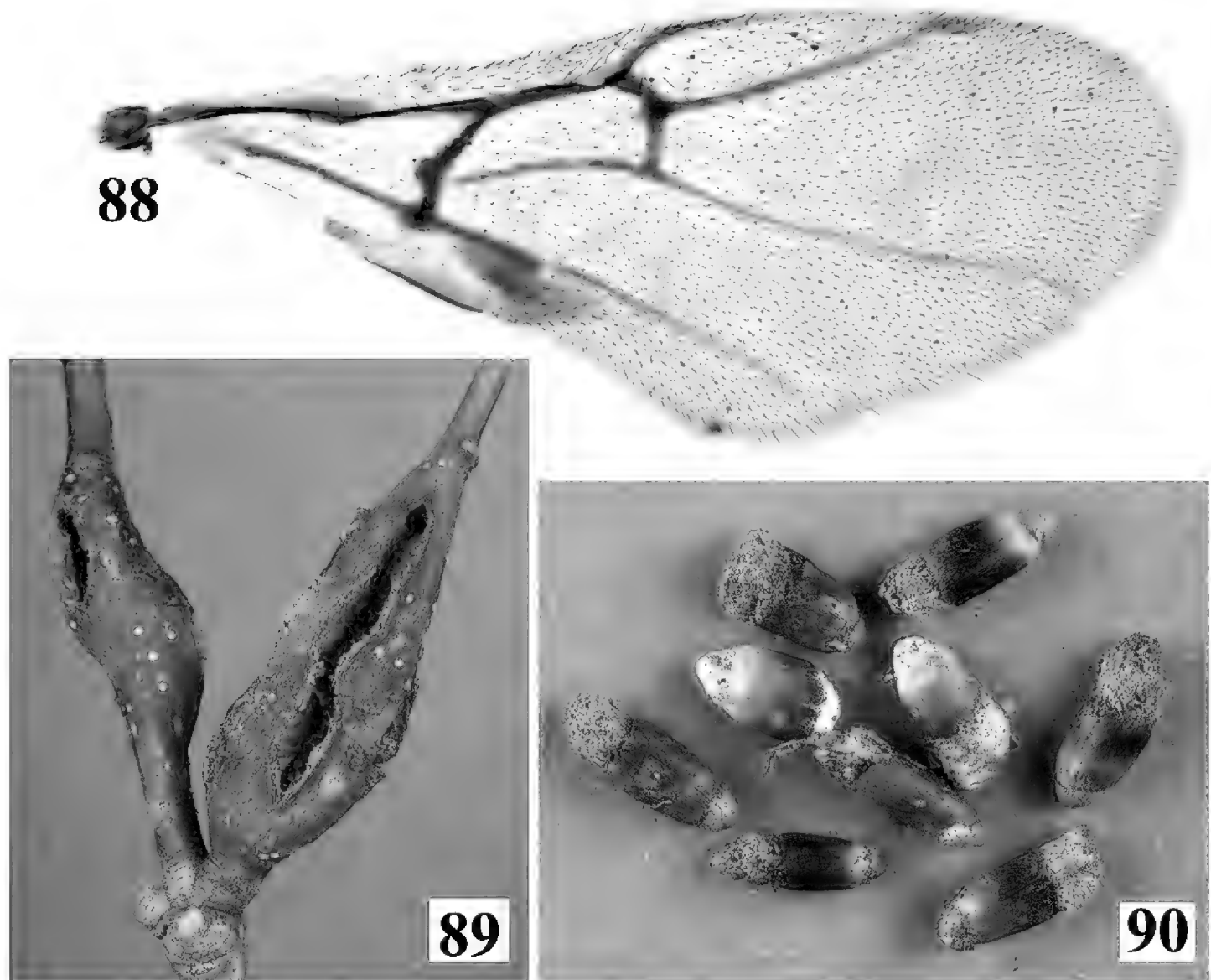
Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width:  $>1$ . Disc of mesoscutellum sculpture: smooth. Disc of mesoscutellum maximum width: in posterior  $1/3$ . Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: semilunar. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 1.8. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: absent. Mesopleuron sculpture: smooth transepisternal line is marked by few delicate sulci, area dorsal to transepisternal line smooth except few short transverse

anterior striae. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: smooth. Mesopleural triangle reflectivity: glossy. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: white. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture in its mid-height. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: present. Metanotal trough pilosity density: rare. Ventral impressed area of metanotum sculpture: smooth with some striae. Metascutellum height / ventral impressed area of metanotum height: NOT CODED. Central propodeal area sculpture: smooth, with two distinct submedial longitudinal rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: smooth with irregular rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 5. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: absent. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/2. Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: NOT CODED. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.30–2.50 mm (n=6).

Gall (Figs 89–90): The gall is a multilocular stem swelling, similar to the asexual galls of *Dryocosmus taitungensis*. The gall is dehiscent when mature, larval cells drop off from the gall (stem swelling) during the winter and they overwinter in the leaf litter. The mature gall is 3.78–5.38 cm in length, and 1.05–1.28 cm in width (n=2). The larval cell is oblong, 4.78–5.68 mm long, and 1.74–2.13 mm wide (n=5).



**Figures 88–90.** *Dryocosmus hualieni*, sp. n. **88** fore wing, female, part. **89–90** galls (photos by C.-T. Tang): **89** gall, general view **90** larval chambers.

**Biology.** The gall maturation in late autumn and the emergence of adults in spring, suggests that the asexual generation is described here. The sexual generation remains unknown. The host-plant is *Q. glauca*.

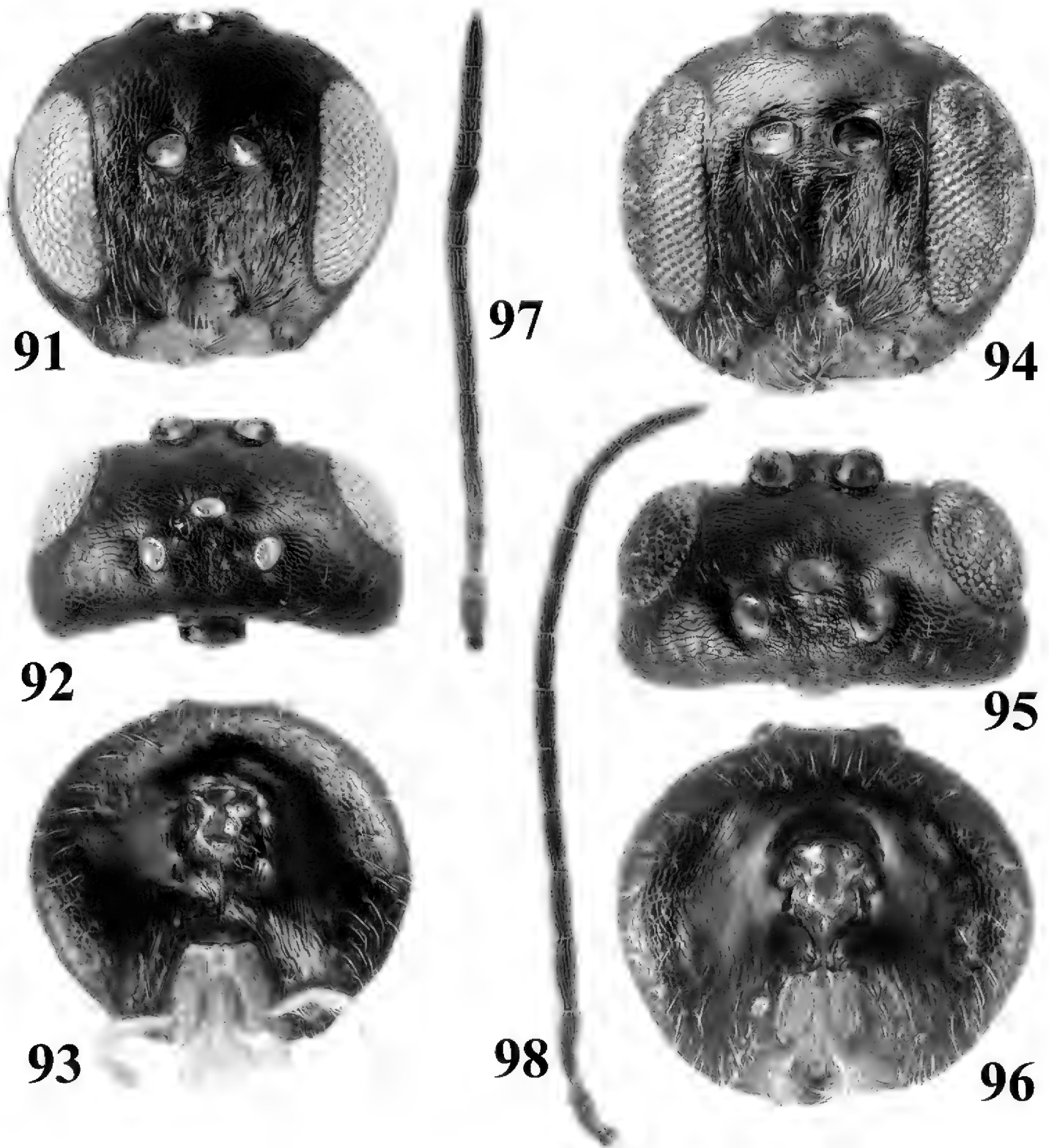
**Distribution.** Taiwan: Hualien County, Xiulin Township.

***Dryocosmus konradi* Tang & Melik, sp. n.**

<http://zoobank.org/AFA7387F-1ABC-4885-BB4A-D8ED1637B279>

Figures 91–104

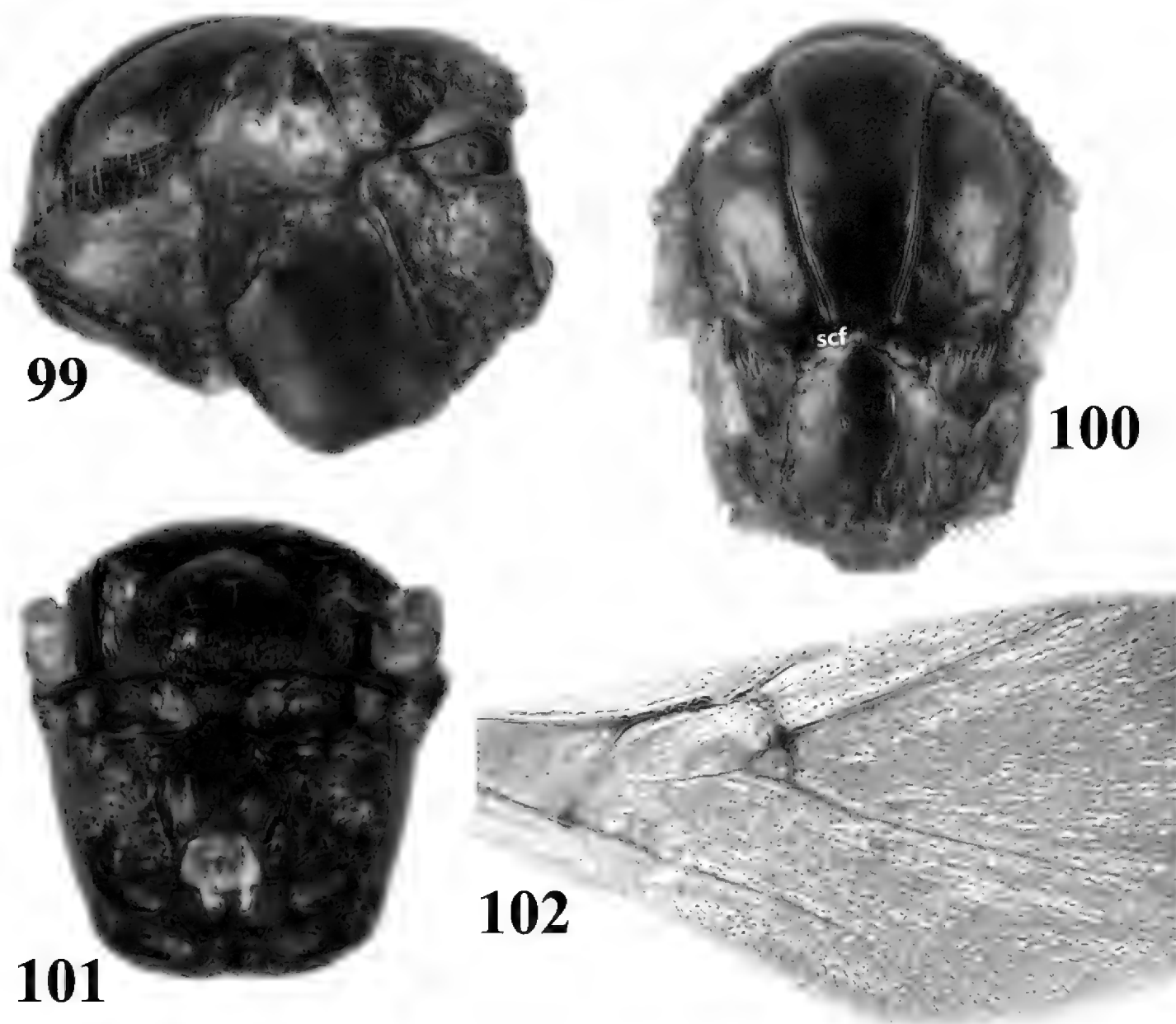
**Type material.** HOLOTYPE female: TAIWAN: Nantou Co., Mt. Guandou, western peak, Renai Township, ex *Quercus longinux*, 22.III.2011 (TAI84), 24.014233°N, 120.981033°E, 1270m, ex small oval yellow gall towards base of young buds, (AG-WP-Morpho28), em. 31.III.2011, leg. C. T. Tang, F. Sinclair, J. Hearn, K. Lohse. PARATYPES: 10 females and 4 males: 2 female paratypes with the same labels as holotype; 1 male and 6 female paratypes: TAIWAN: Nantou Co., Mt. Guandou, western peak, Renai Township, ex *Quercus longinux*, 22.III.2011 (TAI84), 24.014233°N,



**Figures 91–98.** *Dryocosmus konradi*, sp. n. **91–93** head, female: **91** frontal view **92** dorsal view **93** posterior view **94–96** head, male: **94** frontal view **95** dorsal view **96** posterior view **97–98** antenna: **97** female **98** male.

120.981033°E, 1270m, ex small oval yellow gall towards base of young buds, (AGWP-Morpho28), em. 27.III.2011, leg. C. T. Tang, F. Sinclair, J. Hearn, K. Lohse; 1 female paratype: TAIWAN: Nantou Co., road to Lingxiao Temple, Renai Township, ex *Quercus glauca*, 26.IV.2011 (TWT499), 24°59'48.08"N, 121°00'51.52"E, 774m, ex oval-shaped gall at bud base (AGWP-Morpho28), adult em. 28.IV.2011, leg. Chang-Ti Tang; 1 male and 1 female paratypes: TAIWAN: Nantou Co., road to Lingxiao Temple, Renai Township, ex *Quercus glauca*, 26.IV.2011 (TWT499), 24°59'48.08"N, 121°00'51.52"E, 774m, ex oval-shaped gall at bud base (AGWP-





**Figures 99–102.** *Dryocosmus konradi*, female, sp. n. **99–100** mesosoma: **99** lateral view **100** dorsal view **101** metascutellum and propodeum, posterodorsal view **102** fore wing, part (scf=scutellar fovea).

Morpho28), adult em. 29.IV.2011, leg. Chang-Ti Tang; 2 male paratypes: TAIWAN: Nantou Co., road to Lingxiao Temple, Renai Township, ex *Quercus glauca*, 26.IV.2011 (TWT499), 24°59'48.08"N, 121°00'51.52"E, 774m, ex oval-shaped gall at bud base (AGWP-Morpho28), adult em. 30.IV.2011, leg. Chang-Ti Tang.

The female holotype, 2 female and 1 male paratypes are deposited in NMNS, 4 female and 2 male paratypes in PHMB, 4 female and 1 male paratypes in NCHU.

**Etymology.** In recognition of the continuous contribution of Dr. Konrad Lohse (Institute of Evolutionary Biology, University of Edinburgh, Scotland) in related studies on oak gallwasps.

**Diagnosis.** See diagnosis for *Dryocosmus hualieni*.

**Description.** Sexual female: Head color: black to dark brown, clypeus lighter; mandibles, maxillary and labial palps yellowish; scape, pedicel and F1 light brown, subsequent flagellomeres progressively darker. Mesosoma and metasoma color: dark brown, except lighter tegula; legs yellow.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 1.70. Head width / head height: 1.10. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.71. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 3.84. Inner margins of eyes: converging ventrally. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.30. OOL / diameter of lateral ocellus: 2.0. OOL / LOL: 1.60. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.10. Diameter of torulus / intertorular distance: 1.0. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.05. Lower face sculpture: alutaceous except median elevated area coriaceous. Lower face pilosity color: NOT CODED. Lower face pilosity density: NOT CODED. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: coriaceous. Frons pilosity density: NOT CODED. Frons reflectivity: NOT CODED. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: NOT CODED. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: NOT CODED. Vertex reflectivity: NOT CODED. Vertex pilosity color: NOT CODED. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: NOT CODED. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: glossy. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous with delicate rugae along oral foramen. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: NOT CODED. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: <1.0. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1. F1 length / pedicel length: 2.7. F1 length / F3 length: 1.00. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11. F4–F7 relative length: F4>F5>F6>F7. F3 length/F2 length: NOT CODED. F3 length / F4 length: 1.1. F8 length / F7 length: 1.4. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: F9 <F10 <F11. F10

length / F11 length: NOT CODED. F12 length / F11 length: 1.76. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F1–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.17. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: foveolate. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: absent. Mesoscutum length / transscutal line: 1.2. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: 1.00. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: present. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): smooth medially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: smooth. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth without longitudinal rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 2. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: smooth, striae marking transepisternal line absent. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: alutaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: absent. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: NOT CODED. Dorsoaxillar area sculpture: smooth. Dorsoaxillar area reflectivity: glossy. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: smooth. Lateroaxillar area reflectivity: glossy. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1.2. Metapleural sulcus anterior end: reaches mesometapleural suture slightly dorsally of its mid-height. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: NOT CODED. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral

impressed area of metanotum height: 0.8. Central propodeal area sculpture: smooth with irregular rugae. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high slightly curved laterally in mid-height. Lateral propodeal area sculpture: lateral propodeal area alutaceous, with some piliferous punctures. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: white. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.75. Rs+M vs basalis: reaches basalis at half of its height. Rs+M color: dark brown proximally, lighter distally. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/3. Second metasomal tergite pilosity: present laterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 2.10. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.10–2.30 mm (n=3).

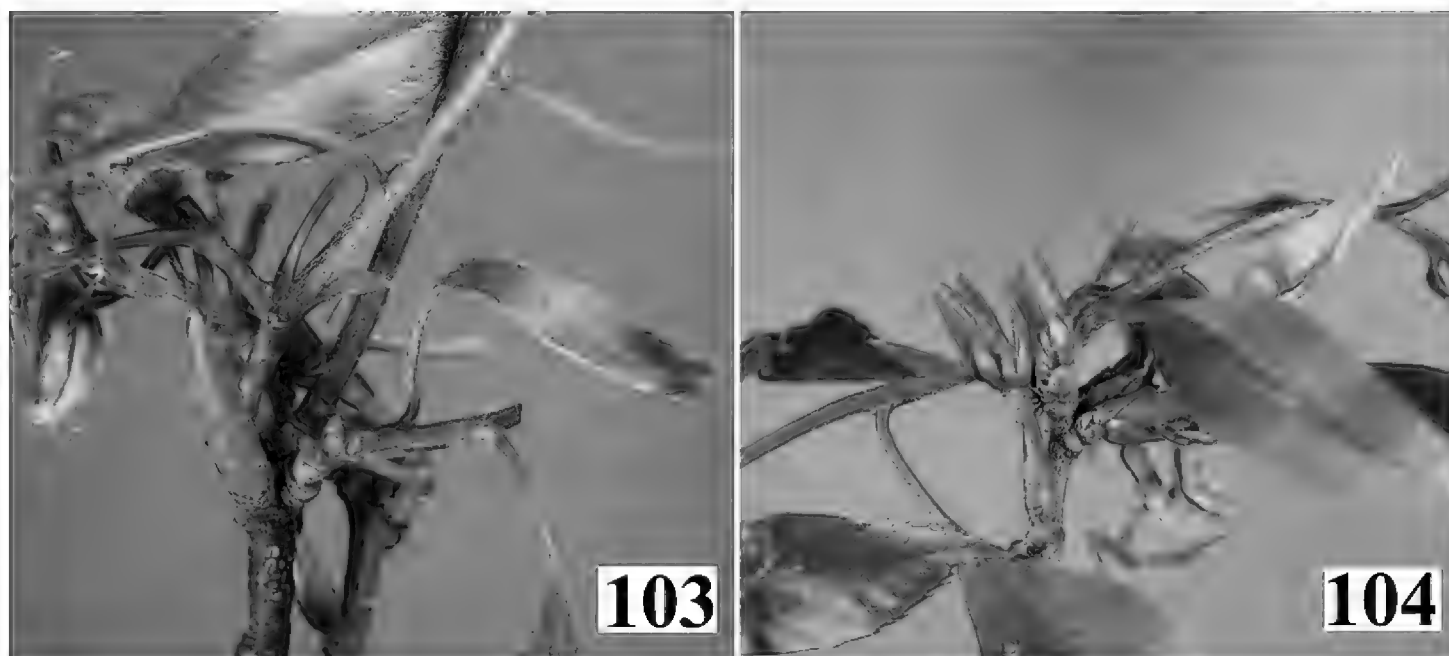
Male: Similar to female. Color: Head, mesosoma and metasoma black; antenna brown; scape, pedicel and F1 light brown; F2–F13 dark brown. Eye size vs female eye size: eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of torulus / intertorular distance: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus: 1.48. Flagellomeres count: 13. Antenna length / body length: >1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 1. Flagellomeres relative length: F2>F3>F4>F5>F6>F9>F10>F11>F12. F13 length / F12 length: 1.13. Placoid sensilla present on: F2–F13. Body length: 1.5–1.7 mm (n=2).

Gall (Figs 103–104): The gall is single-chambered and ovate, greenish with a yellowish central area, 2.3–2.8 mm in length, 1.3–2.1 mm in width (n=5). Galls are located at the base of young shoots, covered by bud scales and are cryptic unless bud scales are removed.

**Biology.** Only the sexual generation is known. Galls were collected from late March through April on *Q. glauca* and *Q. longinux*; adults emerge from galls under laboratory conditions immediately after field collection.

**Distribution.** Taiwan: Renai Township, Nantou County. *Quercus glauca* is widespread from India through China to Japan; it is possible that this *Dryocosmus* species occurs in these regions as well.

**Comments.** Some specimens reared from galls on *Quercus longinux* slightly differ from those reared from galls on *Q. glauca* (the description given above): the head and mesosoma have weaker coriaceous sculpture, the head, mesosoma, and metasoma are more glossy; the mesoscutum narrower; F1 in females slightly shorter.



**Figures 103–104.** *Dryocosmus konradi* sp. n., galls (photos by C.-T. Tang).

***Dryocosmus liyingi* Melika & Tang, sp. n.**

<http://zoobank.org/1CFE5699-CBF1-4901-B799-785B5872FE5B>

Figures 105–121

**Type material.** HOLOTYPE female: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT501), 24°04'49.68"N, 121°10'14.03"E, 2217m, ex multi-chamber leaf-swelling on young bud (AGWP-Morpho30), em. 1.V.2011, leg. Chang-Ti Tang. 18 female and 16 male PARATYPES: 1 female and 1 male paratypes with the same labels as holotype; 5 male paratypes: TAIWAN: Nantou Co., Cuifeng, Renai Township, ex. multi-chambered leaf swelling at young bud on *Quercus morii* (AGWP-Morpho30), 24°05'26.6"N, 121°10'28.9"E, 2114m, gall collected 20.III.2012 (TWT580), adult emerged 23.III.2012, leg. Chang-Ti Tang; 15 female and 8 male paratypes: TAIWAN: Nantou Co., Cuifeng, Renai Township, ex multi-chambered leaf swelling at young bud on *Quercus morii* (AGWP-Morpho30), 24°05'26.6"N, 121°10'28.9"E, 2114m, gall collected 20.III.2012 (TWT580), adult emerged 26.III.2012, leg. Chang-Ti Tang; 2 female and 2 male paratype: TAIWAN: Nantou Co., Cuifeng, Renai Township, ex multi-chambered leaf swelling at young bud on *Quercus morii* (AGWP-Morpho30), 24°05'26.6"N, 121°10'28.9"E, 2114m, gall collected 20.III.2012 (TWT580), adult emerged 27.III.2012, leg. Chang-Ti Tang.

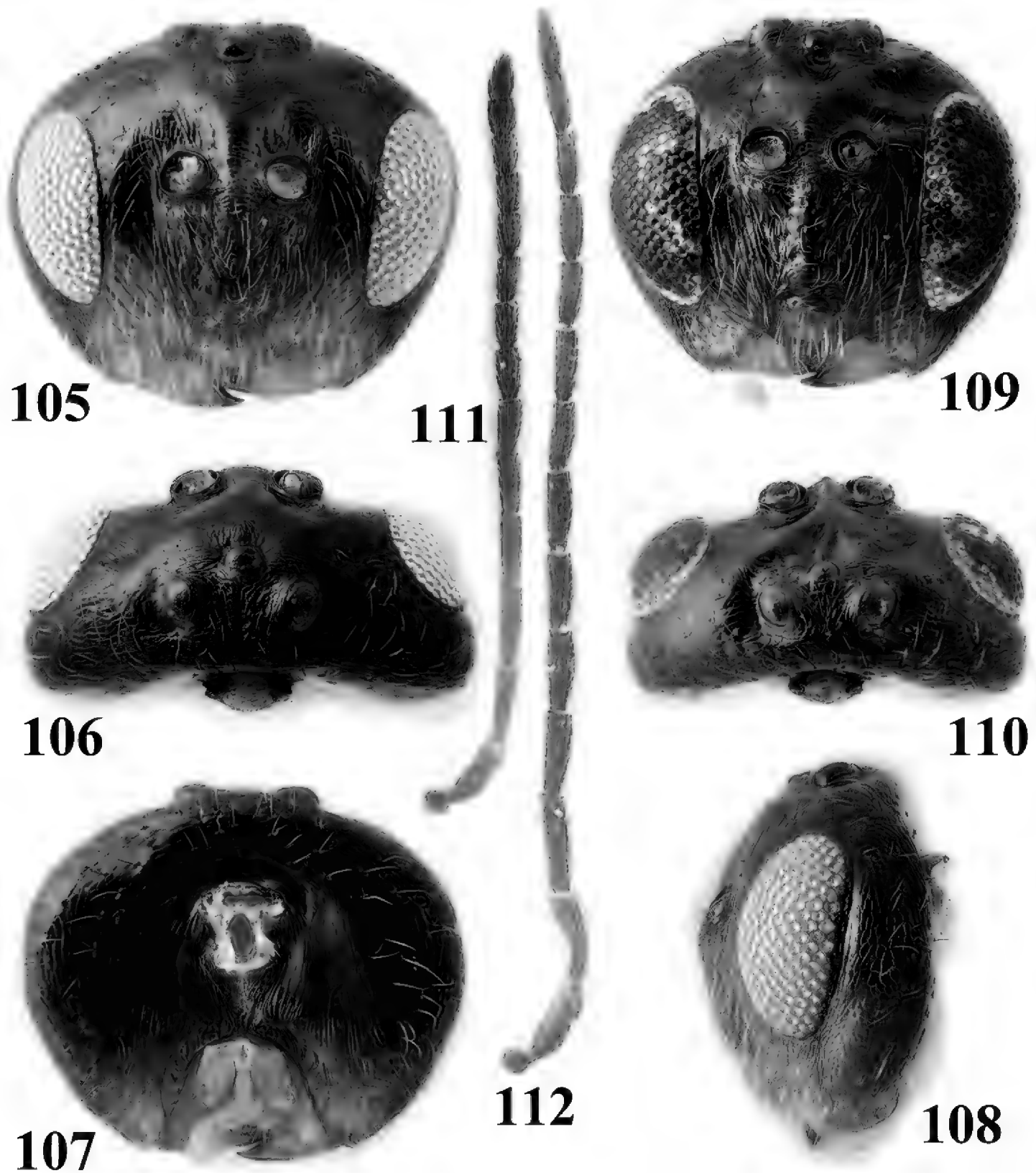
The female holotype, 5 female and 3 male paratypes are deposited in NMNS, 5 female and 7 male paratypes in PHMB, 3 female and 3 male paratypes in USNM, 5 female and 3 male paratypes in NCHU.

**Etymology.** Named after Liying Mountain in Renai Township, Nantou Co., Taiwan, where it was first recorded.

**Diagnosis.** *Dryocosmus liyingi* resembles *D. crinitus*, see Diagnosis for *D. crinitus*. The species is also similar to *Dryocosmus sakureiensis*. In *Dryocosmus liyingi* the mesopleuron lacks striae and in *D. sefuriensis* the mesopleuron is striate anteromedially.

**Description.** Sexual female:



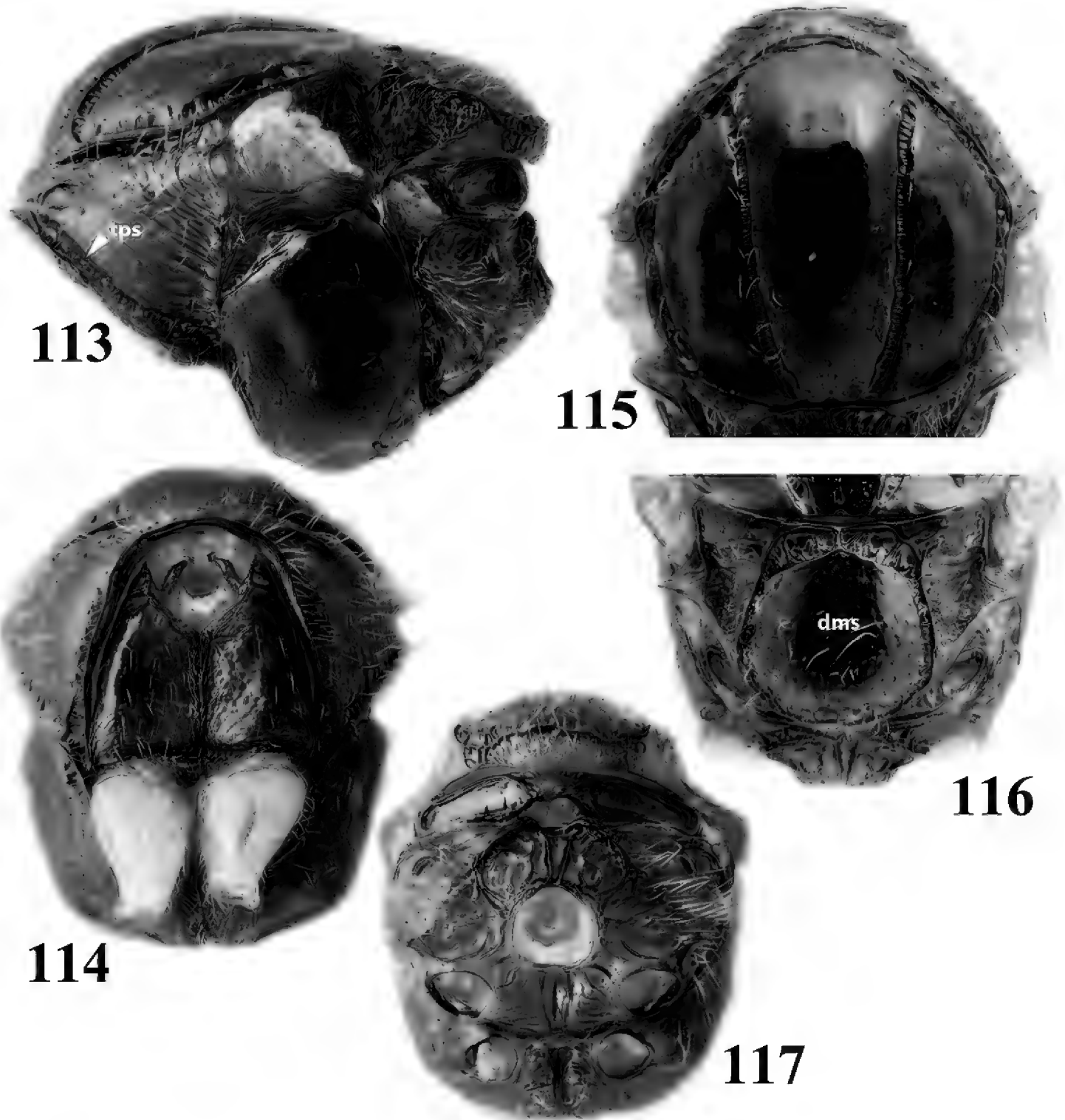


**Figures 105–112.** *Dryocosmus liyingi* sp. n. **105–108** head, female: **105** frontal view **106** dorsal view **107** posterior view **108** lateral view **109–110** head, male: **109** frontal view **110** dorsal view **111–112** antenna: **111** female **112** male.

Head color: dark brown except for lighter lower face and clypeus, mandibles, maxillary and labial palps yellowish; scape and pedicel yellow, subsequent flagellomeres progressively darker. Mesosoma and metasoma color: dark brown, except for lighter tegula and propodeum, legs yellowish. Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 1.90. Head width / head height: 1.17. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous; alutaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.83. Gena shape: broad-

ened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.32. Inner margins of eyes: converging ventrally. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.06. OOL / diameter of lateral ocellus: 2.10. OOL / LOL: 2.05. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.44. Diameter of torulus / intertorular distance: 0.80. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.28. Lower face sculpture: alutaceous. Lower face pilosity color: NOT CODED. Lower face pilosity density: NOT CODED. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: glossy. Clypeus shape anterior view: pentagonal. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: indistinct. Clypeo-pleurostomal line: indistinct. Frons sculpture: alutaceous, impressed above torulus. Frons pilosity density: glabrous. Frons reflectivity: NOT CODED. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: glossy. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: glossy. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: glossy. Occiput pilosity color: white. Postocciput sculpture: alutaceous. Postocciput reflectivity: glossy. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, elongated. Impression adjacent ventrally to posterior tentorial pit: NOT CODED. Postgena sculpture: alutaceous. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: NOT CODED. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: <1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: coriaceous medially. Number of flagellomeres (female): 13. Antenna length / body length: <1. Pedicel length / pedicel width: NOT CODED. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 0.82. F1 length / pedicel length: 2. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3 > F4 > F5 > F6 > F7 > F8 > F9 > F10 > F11 > F12. F4–F7 relative length: NOT CODED. F3 length / F2 length: 0.85. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: NOT CODED. F13 length / F12 length: 1.36. Placoid sensilla present on: F2–F13. Mesosoma length lateral view / mesosoma height lateral view: 1.15.

Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus

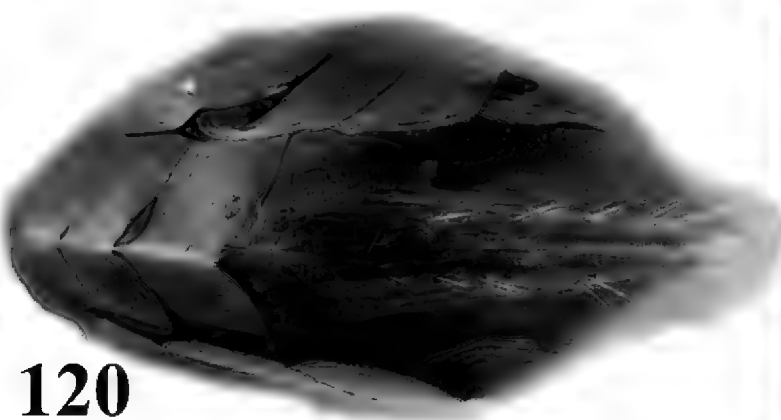
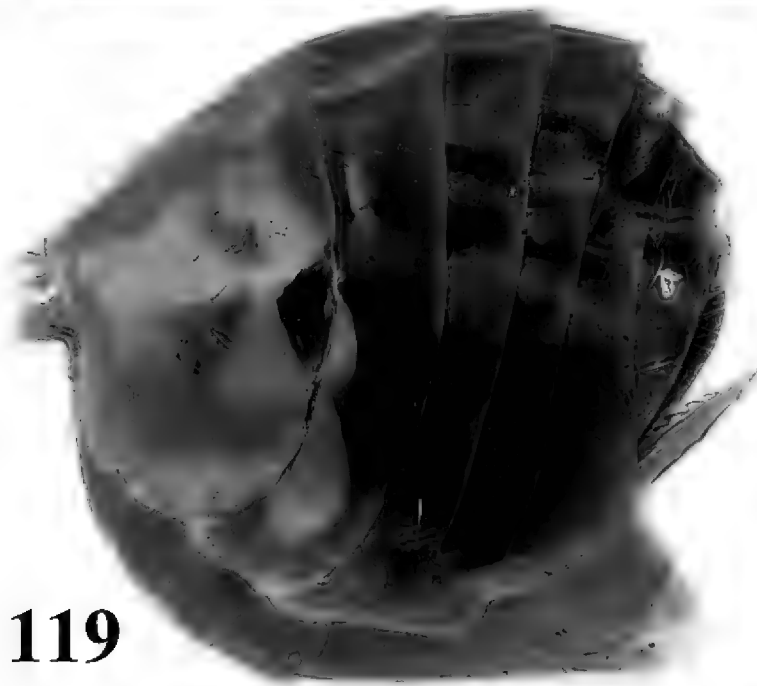
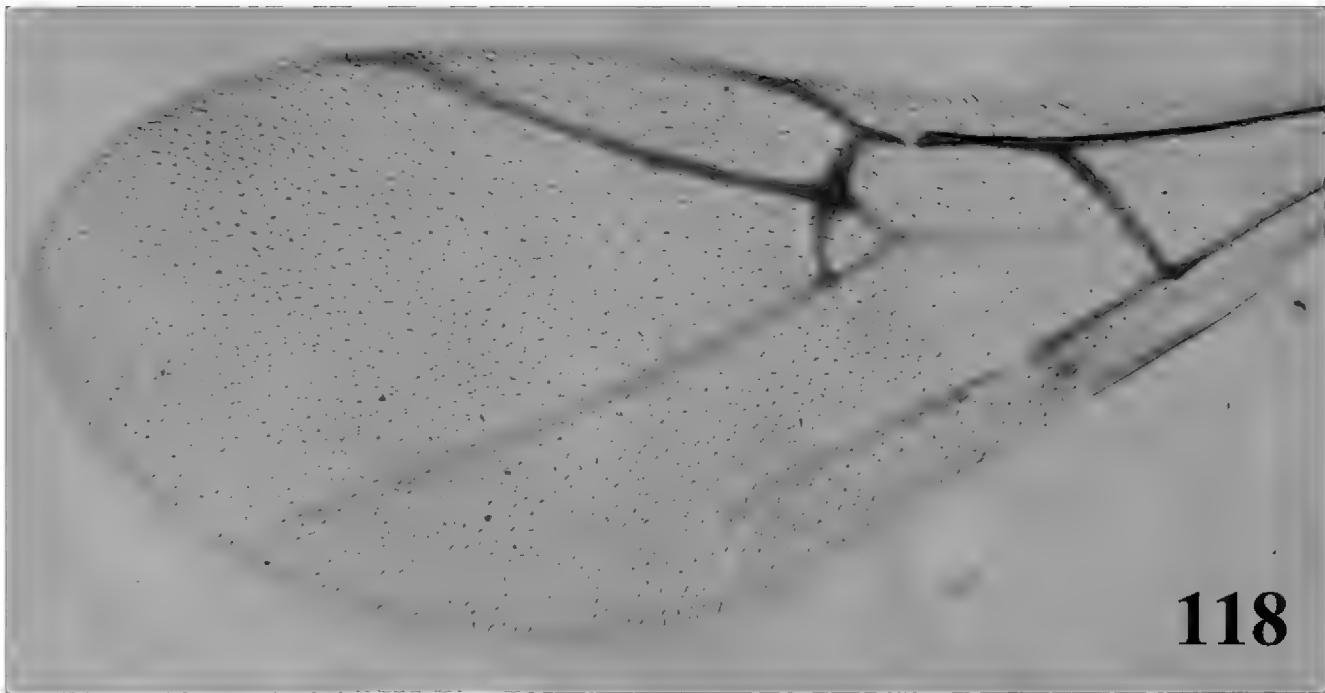


**Figures 113–117.** *Dryocosmus liyingi*, female, sp. n. **113** mesosoma, lateral view **114** pronotum and propleuron, frontal view **115** mesoscutum, dorsal view **116** mesoscutellum, dorsal view **117** metascutellum and propodeum, posterior view (tps=transverse pronotal sulcus, dms=disc of mesoscutellum).

sculpture: foevolate. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1.03. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: crenulate. Notaulus posterior region width / anterior region width: 1.00. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: present. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum

median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): alutaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: smaller than one. Disc of mesoscutellum sculpture: smooth. Disc of mesoscutellum maximum width: NOT CODED. Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: absent. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 2.5. Scutellar fovea minimum diameter / foveal septum width: 6–10. Postacetabular sulcus count: present. Mesopleuron sculpture: smooth, striae marking transepisternal line absent. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: glabrous. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: alutaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: NOT CODED. Dorsoaxillar area sculpture: smooth. Dorsoaxillar area reflectivity: glossy. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: rugose. Lateroaxillar area reflectivity: glossy. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture in upper  $\frac{1}{3}$  of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: NOT CODED. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 0.9. Central propodeal area sculpture: smooth with longitudinal rugae. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high, strongly curved laterally in mid-height. Lateral propodeal area sculpture: lateral propodeal area alutaceous. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: white. Lateral propodeal area pilosity density: rare. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.78. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown proximally, lighter distally. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 0.40. Second metasomal tergite pilosity: present mediolaterally.



**Figures 118–121.** *Dryocosmus liyingi* sp. n. **118** fore wing, part, female **119–120** metasoma, female: **119** lateral view **120** ventral view **121** gall (photo by C.-T. Tang).

Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygi-



um length ventral view / Prominent part of ventral spine of hypopygium width ventral view: NOT CODED. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.10–2.20 mm (n=5).

Male: Similar to female. Color: Head and mesosoma dark brown, with lighter lower face and mouth parts; metasoma dark brown; antenna light brown. Eye size vs female eye size: eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of torulus / intertorular distance: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus: NOT CODED. Flagellomeres count: 13. Antenna length / body length: >1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 1. Flagellomeres relative length: F2>F3>F4>F5>F6>F9>F10>F11>F12. F13 length / F12 length: 1.17. Placoid sensilla present on: F2–F13. Body length: 1.8–1.9 mm (n=5).

Gall (Fig. 121): The gall resembles the sexual galls of *Dryocosmus sefuriensis*. The gall is a cluster of multiple larval chambers, and covered by bud scales and young leaves in a bud. The infected bud becomes thicker and the young shoot will not develop, providing a clue to search for galls on the host-plant. The mature gall is yellowish-white.

**Biology.** Only the sexual generation is known. Galls were collected from late March to late April. Adults emerged from galls in the laboratory immediately after collection. Galls are on *Q. morii* and *Q. sessilifolia*.

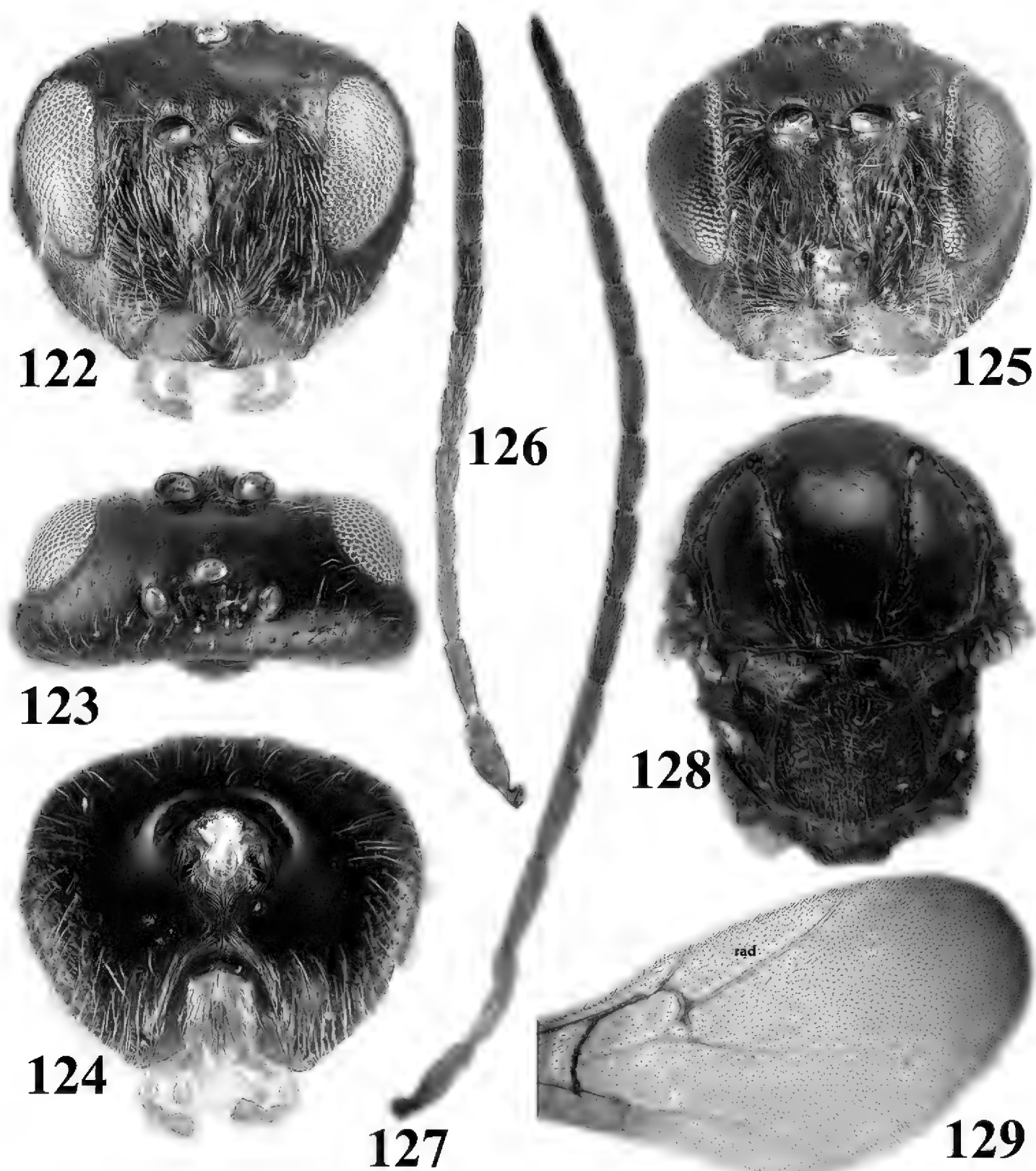
**Distribution.** Taiwan: Renai Township, Nantou County.

***Dryocosmus moriius* Tang & Melika, sp. n.**

<http://zoobank.org/9C8A4DD6-E635-4B7A-A8EB-02646151D521>

Figures 122–135

**Type material.** HOLOTYPE female: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT474), 24°04'49.68"N, 121°10'14.03"E, 2217m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 26.IV.2011, leg. Chang-Ti Tang. PARATYPES: 31 females and 8 males: 3 female paratypes with the same labels as holotype; 2 male and 2 female paratypes: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT474), 24°04'49.68"N, 121°10'14.03"E, 2217m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 27.IV.2011, leg. Chang-Ti Tang; 3 female paratypes: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT474), 24°04'49.68"N, 121°10'14.03"E, 2217m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 28.IV.2011, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT474), 24°04'49.68"N, 121°10'14.03"E, 2217m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 2.V.2011, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., Mt. Liying, Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT474), 24°04'49.68"N, 121°10'14.03"E,



**Figures 122–129.** *Dryocosmus moriinus* sp. n. **122–124** head, female: **122** frontal view **123** dorsal view **124** posterior view **125** head, frontal view, male **126–127** antenna: **126** female **127** male **128–129** female: **128** mesosoma, dorsal view **129** fore wing, part, female (rad=radial cell).

2217m, ovipositing female on young leaves of host plant, leg. Chang-Ti Tang; 2 male and 1 female paratypes: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 1.V.2011, leg. Chang-Ti Tang; 1 male and 3 female paratypes: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 2.V.2011,

leg. Chang-Ti Tang; 1 male and 1 female paratypes: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 3.V.2011, leg. Chang-Ti Tang; 3 female paratypes: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 6.V.2011, leg. Chang-Ti Tang; 2 female paratypes: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 9.V.2011, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., near Cuifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT498), 24°06'06.63"N, 121°11'24.47"E, 2285m, ex small green oval bud gall cover by bud-scales (TWTb13), em. 13.V.2011, leg. Chang-Ti Tang; 1 male and 3 female paratypes: TAIWAN: Nantou Co., near Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT502), 24°05'19.33"N, 121°10'17.98"E, 2120m, ex small oval green bud gall cover by bud-scales (TWTb13), em. 27.IV.2011, leg. Chang-Ti Tang; 1 male and 4 female paratypes: TAIWAN: Nantou Co., near Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT502), 24°05'19.33"N, 121°10'17.98"E, 2120m, ex small oval green bud gall cover by bud-scales (TWTb13), em. 28.IV.2011, leg. Chang-Ti Tang; 2 female paratypes: TAIWAN: Nantou Co., near Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT502), 24°05'19.33"N, 121°10'17.98"E, 2120m, ex small oval green bud gall cover by bud-scales (TWTb13), em. 29.IV.2011, leg. Chang-Ti Tang; 1 female paratype: TAIWAN: Nantou Co., near Meifeng, Renai Township, ex *Quercus morii*, 25.IV.2011 (TWT502), 24°05'19.33"N, 121°10'17.98"E, 2120m, ex small oval green bud gall cover by bud-scales (TWTb13), em. 3.V.2011, leg. Chang-Ti Tang.

The female holotype, 9 female and 2 male paratypes are deposited in NMNS, 9 female and 3 male paratypes in PHMB, 3 female and 1 male paratypes in USNM, 10 female and 2 male paratypes in NCHU.

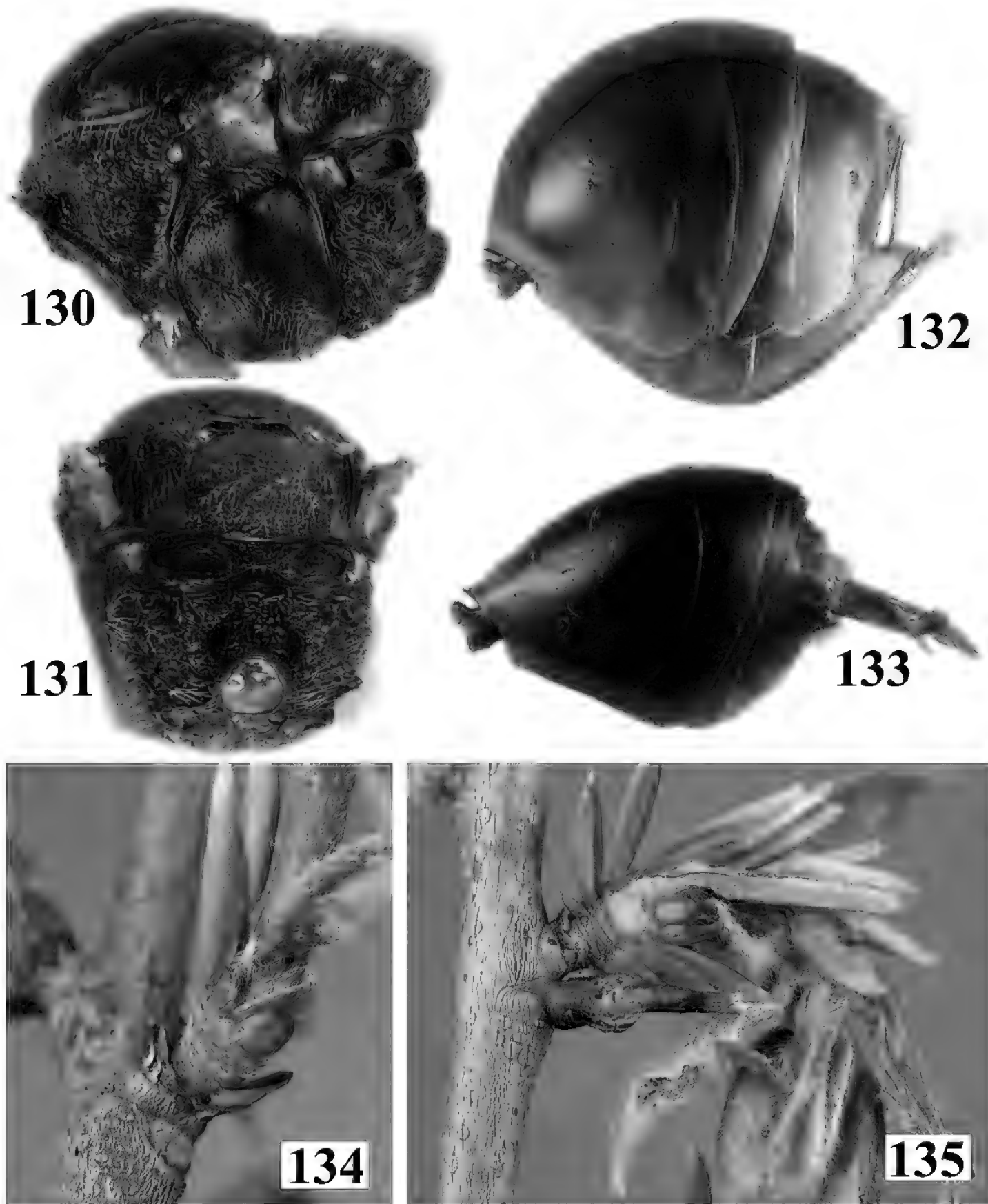
**Etymology.** Named after the host plant, *Q. morii*.

**Diagnosis.** *Dryocosmus mori* is most similar to *D. sakureiensis*, both sharing the presence of a basal lobe on the metatarsal claw.

*Dryocosmus sakureiensis*: Female antenna with 12 flagellomeres; eye height / malar distance = 2.62; intertorular distance / eye torulus distance = 0.67; radial cell length / radial cell width = 3.43; 2nd metasomal tergite length dorsal view / length of metasoma dorsal view > 0.50; prominent part of ventral spine of hypopygium length ventral view / prominent part of ventral spine of hypopygium width ventral view = 2.20.

*Dryocosmus mori*: Female antenna with 13 flagellomeres, eye height / malar distance = 2.0; intertorular distance / eye torulus distance = 0.36; radial cell length / radial cell width = 4.5; 2nd metasomal tergite length dorsal view / length of metasoma dorsal view = 0.33; prominent part of ventral spine of hypopygium length ventral view / prominent part of ventral spine of hypopygium width ventral view = 1.3.

**Description.** Sexual female: Head color: Head black, except for light brown clypeus; mandibles, maxillary and labial palps yellowish; scape, pedicel, F1–F4 light



**Figures 130–135.** *Dryocosmus moriius* sp. n. **130** mesosoma, female, lateral view **131** metascutellum and propodeum, female, posterodorsal view **132–133** metasoma, lateral view: **132** female **133** male **134–135** galls (photos by C.-T. Tang) (vsh=ventral spine of hypopygium).

brown, subsequent flagellomeres progressively darker. Mesosoma and metasoma color: mesosoma black, except for lighter tegula; metasoma dark brown; legs yellowish.

Head sculpture: coriaceous. Head shape anterior view: rounded. Head width / head length: 2.10. Head width / head height: 1.20. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: NOT CODED. Gena

length / eye width: 0.94. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.0. Inner margins of eyes: NOT CODED. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.20. OOL / diameter of lateral ocellus: 2.45. OOL / LOL: 1.97. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.30. Diameter of torulus / intertorular distance: 1.72. Intertorular distance / eye torulus distance: 0.4. Eye-torulus distance / diameter of torulus: 1.25. Lower face sculpture: NOT CODED. Lower face pilosity color: NOT CODED. Lower face pilosity density: NOT CODED. Clypeus convexity: NOT CODED. Clypeus sculpture: NOT CODED. Clypeus ventral margin shape: straight. Clypeus reflectivity: matt. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: small, indistinct. Epistomal sulcus: indistinct. Clypeo-pleurostomal line: indistinct. Frons sculpture: alutaceous. Frons pilosity density: rare. Frons reflectivity: NOT CODED. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: alutaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: glossy. Interocellar area pilosity color: white. Vertex sculpture: alutaceous. Vertex pilosity density: rare. Vertex reflectivity: glossy. Vertex pilosity color: white. Occiput sculpture: alutaceous. Occiput pilosity density: rare. Occiput reflectivity: glossy. Occiput pilosity color: white. Postocciput sculpture: smooth. Postocciput reflectivity: glossy. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: absent. Postgena sculpture: alutaceous. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: NOT CODED. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 13. Antenna length / body length: <1. Pedicel length / pedicel width: longer than wide. Pedicel length / length of broadened part of scape: 1.08. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1.1. F1 length / pedicel length: 2.1. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F2–F8 progressively shorter. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length / F8 length: 1.30. F10 length / F9 length: >1. F9–F11 relative length: NOT CODED. F10 length / F11 length: 1.00. F12 length / F11 length: 0.9. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F3–F13.

Mesosoma length lateral view / mesosoma height lateral view: 1.14. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: foevolate. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Ad-



notaular setae: present. Mesoscutum length / transscutal line: 1.35. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: smooth. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: NOT CODED. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: present. Median mesoscutal line shape: triangular. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): rugose medially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior 1/4th. Scutellar fovea sculpture: smooth without longitudinal rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 2.25. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: coriaceous, striae marking transepisternal line absent. Mesopleuron reflectivity: matt. Mesopleuron pilosity: dense setae present just ventral to transepisternal line. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: rugose. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: smooth. Dorsoaxillar area reflectivity: glossy. Dorsoaxillar area pilosity color: white. Dorsoaxillar area pilosity density: rare. Lateroaxillar area sculpture: smooth. Lateroaxillar area reflectivity: glossy. Lateroaxillar area pilosity density: rare. Lateroaxillar area pilosity color: white. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture slightly ventrally of its mid-height. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: NOT CODED. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: rugose. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high, slightly curved laterally in mid-height. Lateral propodeal area sculpture: rugose. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: rare. Nucha

sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 4.5. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: present. Basal lobe on tarsal claw shape: blunt.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/3. Second metasomal tergite pilosity: NOT CODED. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: glossy. Second metasomal tergite pilosity density: NOT CODED. Metasomal tergites 3–6 sculpture: smooth, micropunctate. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 1.30. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.60–2.80 mm (n=5).

Male: Similar to female. Color: Head and mesosoma black, metasoma dark brown, antenna light brown to dark brown. Eye size vs female eye size: eye larger in male. Anterior tentorial pit size: large, distinct. Diameter of torulus / intertorular distance: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus: NOT CODED. Flagellomeres count: 13. Antenna length / body length: >1. F1 shape: F1 curved and broadened apically. F1 length / F2 length: 0.94. Flagellomeres relative length: F2>F3>F4>F5>F6>F9>F10>F11>F12. F13 length / F12 length: 1.2. Placoid sensilla present on: F2–F13. Body length: 2.6–2.8 mm (n=4).

Gall (Figs 134–135): The gall closely resembles the sexual galls of *Dryocosmus saku-reiensis*. The gall is unilocular, ovate, 2.8–3.4 mm long and 1.8–2.1 mm wide (n=5). Galls are at the base of young shoots, usually by bud scales. Galls are green and yellowish white in the central area.

**Biology.** Only the sexual generation is known. Galls are induced on young shoots on *Quercus morii*. Galls were collected in April and adults emerged from galls under laboratory conditions immediately after field collection.

**Distribution.** Taiwan: Renai Township, Nantou County. *Quercus morii* is endemic to Taiwan, suggesting that *Dryocosmus morii* is also endemic to Taiwan.

***Dryocosmus quadripetiolus* Schwéger & Tang, sp. n.**

<http://zoobank.org/C09DF087-BC26-466E-8A08-712688D50FF4>

Figures 136–148

**Type material.** HOLOTYPE female: CHINA: Yunnan Prov., Lan Cang Co., Foufang quarry, ex *Castanopsis echinocarpa*, 11.IV.2011 (CHI38), 22.593300°N, 99.982633°E, 1625m, ex bird head shaped gall with ridges (AGWP-Morpho74), em. 11.IV.2011,

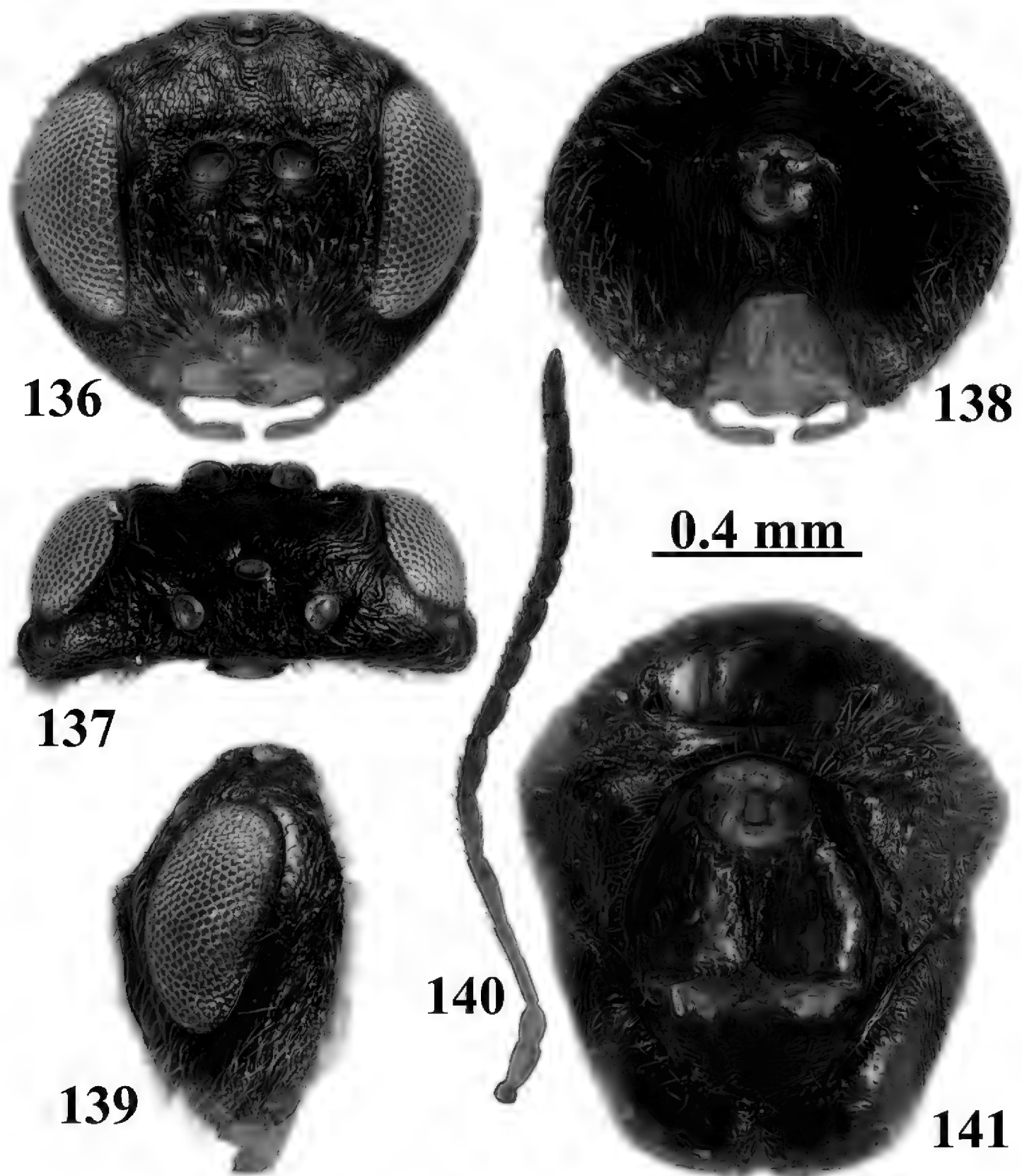
leg. C. T. Tang, F. Sinclair, J. Hearn. One female PARATYPE with the same labels as the holotype.

The female holotype is deposited in NMNS, the female paratype in PHMB.

**Etymology.** Named after the shape of the gall, which has four petiole-like ridges.

**Diagnosis.** In *Dryocosmus quadripetiolus* the mesopleuron is densely setose ventral to the transepisternal line (Fig. 142), while in all other species the mesopleuron is glabrous or with few setae present along the margin of the lateral mesopleural face (Figs 24, 40, 72, 166).

**Description.** Sexual female: Head color: Head black, except for lighter clypeus; mandibles, maxillary and labial palps yellowish brown; scape and pedicel yellow, flagellomeres progressively darker till last one. Mesosoma and metasoma color: mesosoma black, except for lighter tegula; metasoma dark brown; legs yellowish. Head sculpture: coriaceous. Head shape anterior view: NOT CODED. Head width / head length: 2.10. Head width / head height: 1.20. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: matt. Gena length / eye width: 0.50. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 3.33. Inner margins of eyes: NOT CODED. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.50. OOL / diameter of lateral ocellus: 1.80. OOL / LOL: 1.40. Diameter of lateral ocellus / diameter of median ocellus: >1. Transfacial distance / eye height: 1.10. Diameter of torulus / intertorular distance: 1.80. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.20. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: NOT CODED. Clypeus convexity: flat. Clypeus sculpture: NOT CODED. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: coriaceous with irregular rugae between lateral ocellus and compound eye. Frons pilosity density: NOT CODED. Frons reflectivity: matt. Frons pilosity color: NOT CODED. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: matt. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: matt. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: matt. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous with few delicate rugae medially. Postgena reflectivity: glossy. Postgena pilosity color: white. Postgena pilosity density: dense. Postgena pilosity count: absent medially, present laterally. Postgenal bridge /



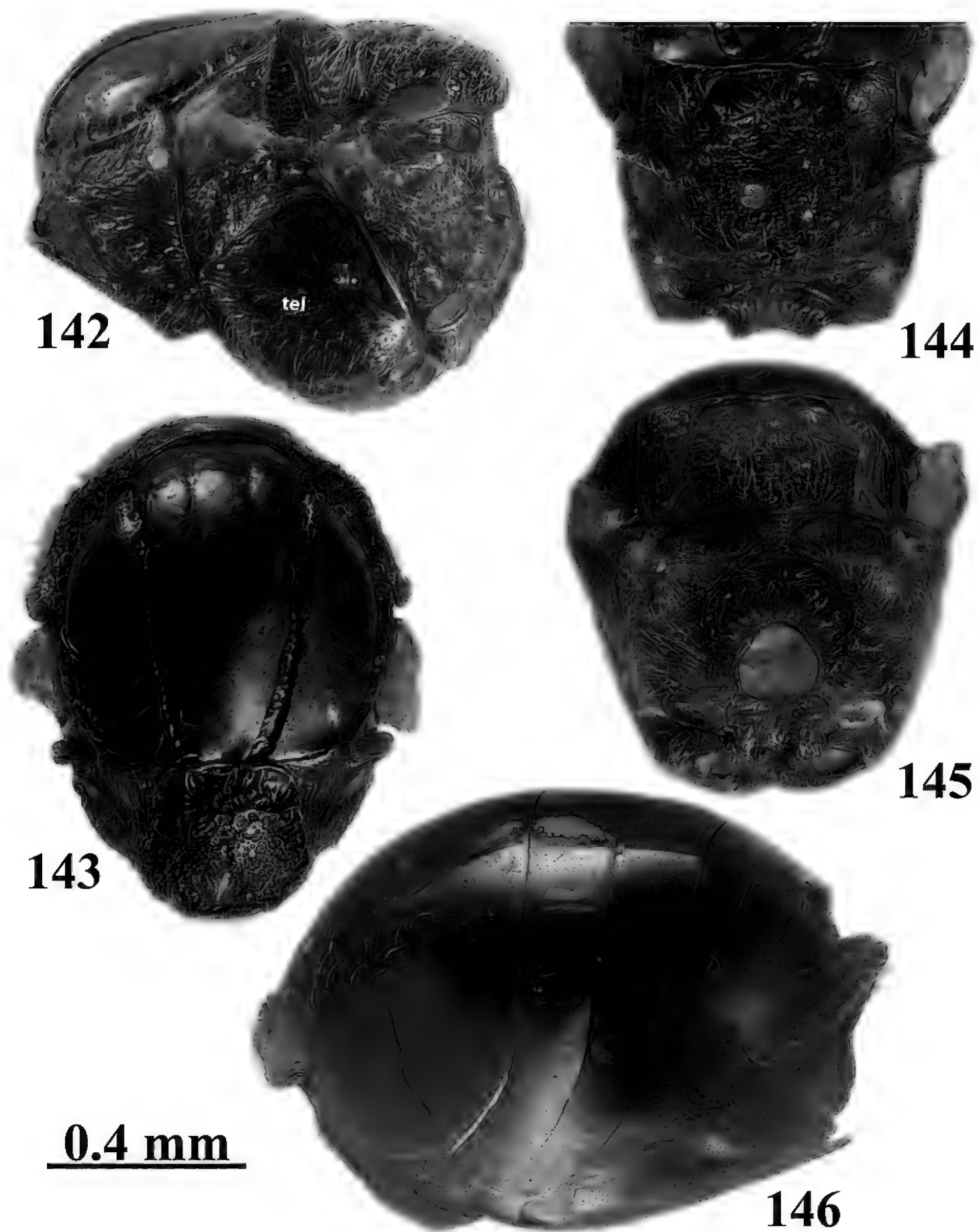
**Figures 136–141.** *Dryocosmus quadripetiolus*, female, sp. n. **136–139** head: **136** frontal view **137** dorsal view **138** posterior view **139** lateral view **140** antenna **141** pronotum and propleuron, frontal view.

height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 13. Antenna length / body length: <1. Pedicel length / pedicel width: 1.40. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1.18. F1 length / pedicel length: 2.25. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11>F12. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length

/ F7 length: NOT CODED. F9 length / F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10 length / F11 length: NOT CODED. F12 length / F11 length: NOT CODED. F13 length / F12 length: 2. Placoid sensilla present on: F2–F13.

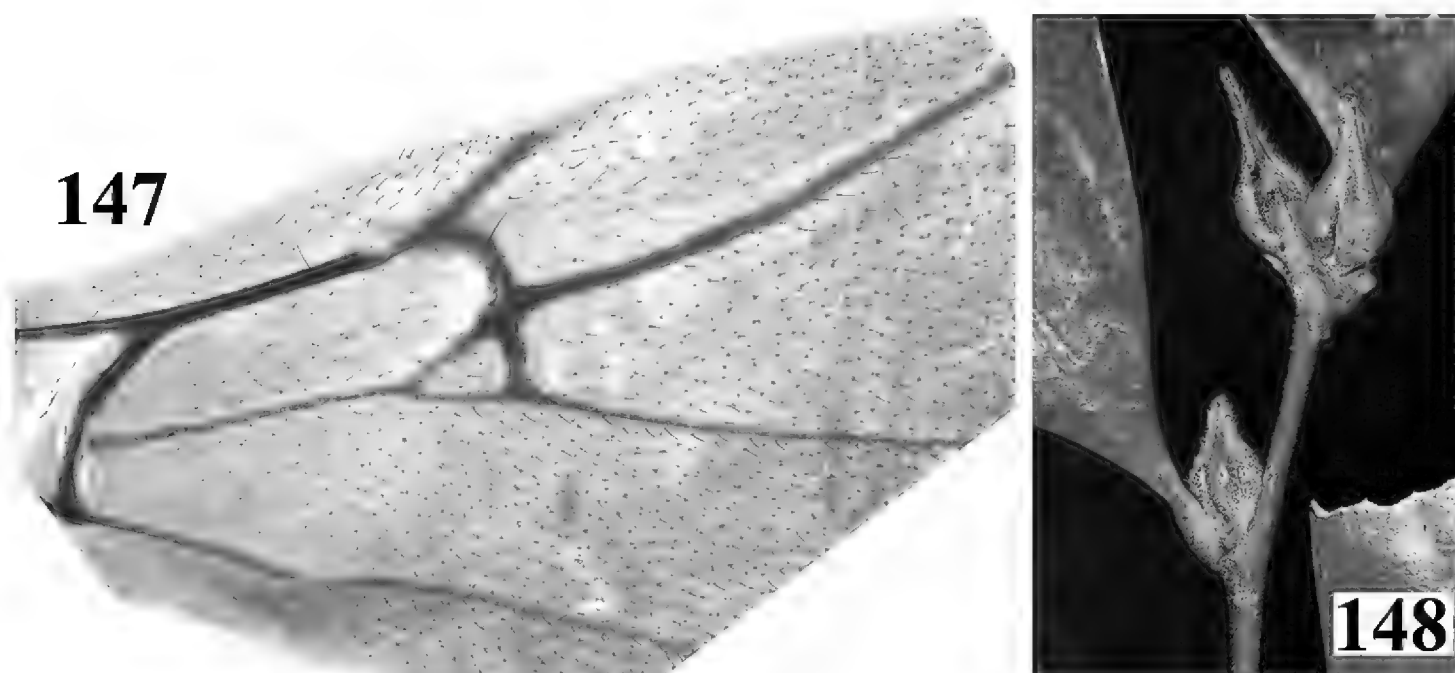
Mesosoma length lateral view / mesosoma height lateral view: 1.2. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present anteriorly. Mesoscutum length / transscutal line: 1.1. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: present. Parapsidal line distinctness: indistinct. Anteroadmedian line: present. Antero-admedian line length / mesoscutum median length: 0.25. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): coriaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: semilunar. Scutellar fovea reflectivity: glossy. Foveal septum: absent. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 1.7. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: NOT CODED. Mesopleuron sculpture: smooth, transepisternal line is marked by few delicate sulci, area dorsal to transepisternal line smooth. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: dense setae present just ventral to transepisternal line. Speculum sculpture: smooth. Speculum reflectivity: glossy. Mesopleural triangle sculpture: coriaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: NOT CODED. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: NOT CODED. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1.27. Metapleural sulcus anterior end: reaches meso-metapleural suture in upper 1/4 of its length. Metascutellum sculpture: coriaceous.





**Figures 142–146.** *Dryocosmus quadripetiolus*, female, sp. n. **142** mesosoma, lateral view **143** mesosoma, dorsal view **144** mesoscutellum, dorsal view **145** metascutellum and propodeum, posterodorsal view **146** metasoma, lateral view (tel=transepisternal line).

Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height



**Figures 147–148.** *Dryocosmus quadripetiolus* sp. n. **147** fore wing, female, part **148** gall (photo by C.-T. Tang).

/ ventral impressed area of metanotum height: 2. Central propodeal area sculpture: smooth with irregular rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, slightly curved laterally in mid-height. Lateral propodeal area sculpture: smooth with irregular rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: dense. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 3.7. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/3. Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: NOT CODED. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.45 mm (n=2).

Male: Unknown.

Gall (Fig. 148): Galls develop from buds, detachable. The body of the gall contains a subglobose part and a needle-like projection; the subglobose part is 5.0–6.0 mm in diameter, 6.0–7.0 in height; the needle-like projection at the top of the gall body nearly as long as or slightly longer than the height of the subglobose part. The gall body is marked

with four longitudinal ribs, pubescent. The mature gall is brownish, similar to the color of the twig. The larval chamber is centrally located at the subglobose part, unilocular.

**Biology.** Based on the morphology, gall maturation and emergence period of adults, the described females represent the sexual generation. Galls are in buds on *Castanopsis echinocarpa*. Galls were collected in April and adults emerged from galls under laboratory conditions immediately after field collection.

**Distribution.** China: Yunnan Province (Lan Cang County).

***Dryocosmus salicinai* Schwéger & Tang, sp. n.**

<http://zoobank.org/5D21585D-E7F1-4C5A-A23F-5A4350206028>

Figures 149–161

**Type material.** HOLOTYPE female: TAIWAN: Taichung City, 104.5 K, Central Cross Island Highway, Heping Dist., ex monolocular bud gall on *Quercus salicina* (TWTb16), 24°12'44.4"N, 121°18'20.2"E, 2437m, gall collected 19.III.2012 (TWT583), adult emerged 4.IV.2012, leg. Chang-Ti Tang. Three female and four male PARATYPES: 4 male paratypes with the same labels as the holotype: 3 female paratypes: TAIWAN: Taichung City, 104.5 K, Central Cross Island Highway, Heping Dist., ex unilocular bud gall on *Quercus salicina* (TWTb16), 24°12'44.4"N, 121°18'20.2"E, 2437m, gall collected 19.III.2012 (TWT583), adult emerged 5.IV.2012, leg. Chang-Ti Tang.

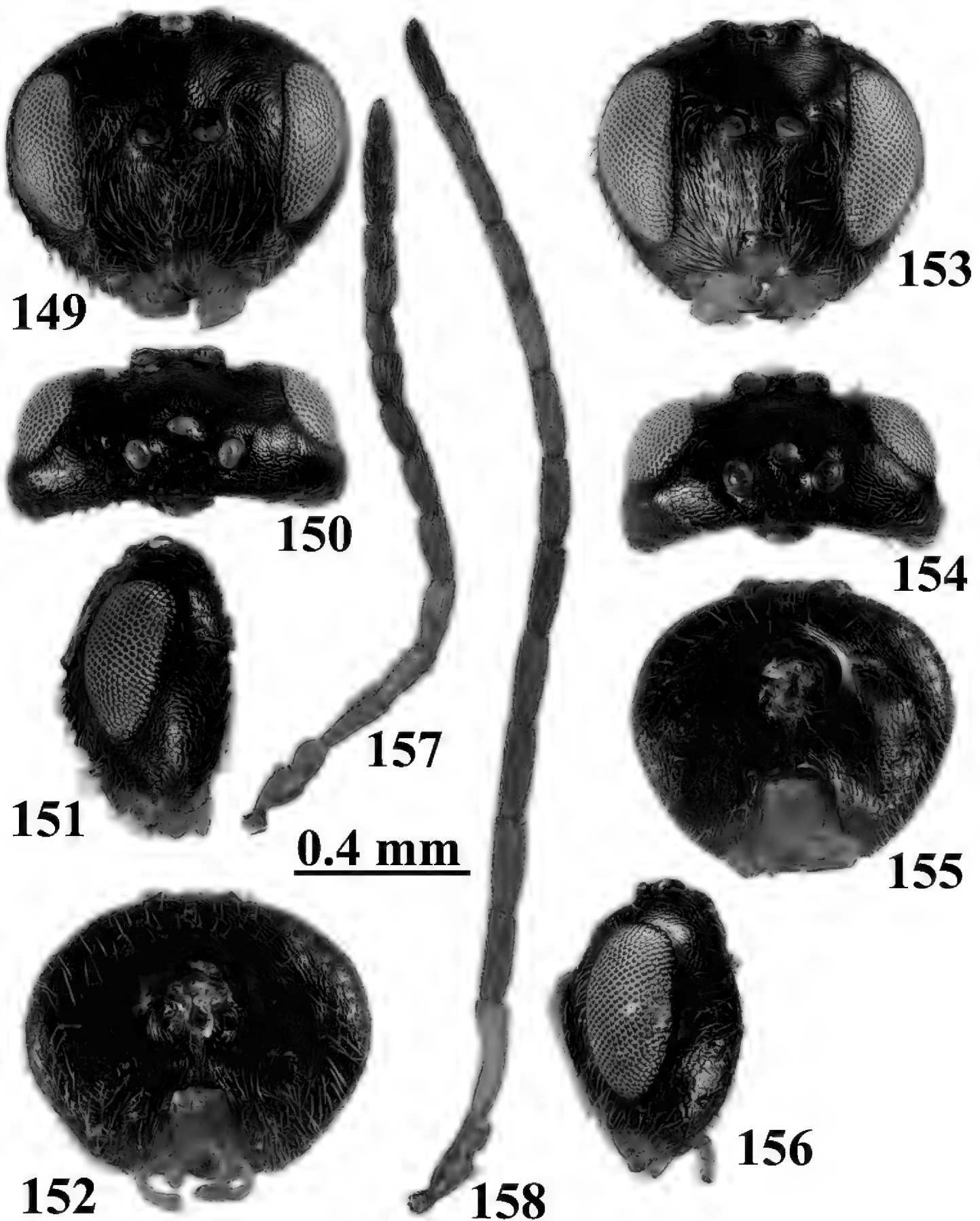
The holotype female, 1 female and 2 male paratypes are deposited in NMNS, 1 female and 1 male paratypes in PHMB, 1 female and 1 male paratypes in NCHU.

**Etymology.** The species is named after the host plant, *Quercus salicina*.

**Diagnosis.** *Dryocosmus salicinai* is the only *Dryocosmus* species in which the mesopleuron and speculum are matt, uniformly coriaceous, without striae. In all other *Dryocosmus* species the mesopleuron and/or speculum are glossy and smooth. Albeit the structure of the mesopleuron is somewhat similar to that of *Plagiotrochus*, based on the presence of the truncate apical tuft on the ventral spine of hypopygium and the smooth and glossy mesoscutum we treat this species as *Dryocosmus*.

**Description.** Sexual female: Head color: black or dark brown, except for lighter clypeus; mandibles, maxillary and labial palps yellowish; scape and pedicel yellowish or light brown, flagellomeres progressively darker till last one. Mesosoma and metasoma color: mesosoma dark brown to black, except for lighter tegula; metasoma dark brown; legs uniformly brown.

Head sculpture: coriaceous. Head shape anterior view: NOT CODED. Head width / head length: 2.20. Head width / head height: 1.25. Head width / maximum mesosoma width: <1. Gena sculpture: coriaceous. Gena reflectivity: matt. Gena length / eye width: 0.40. Gena shape: broadened posterior to eye, visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 2.85. Inner margins of eyes: NOT CODED. Median ocellus



**Figures 149–158.** *Dryocosmus salicinai* sp. n. **149–152** head, female: **149** frontal view **150** dorsal view **151** lateral view **152** posterior view **153–156** head, male: **153** frontal view **154** dorsal view **155** posterior view **156** lateral view **157–158** antenna: **157** female **158** male.

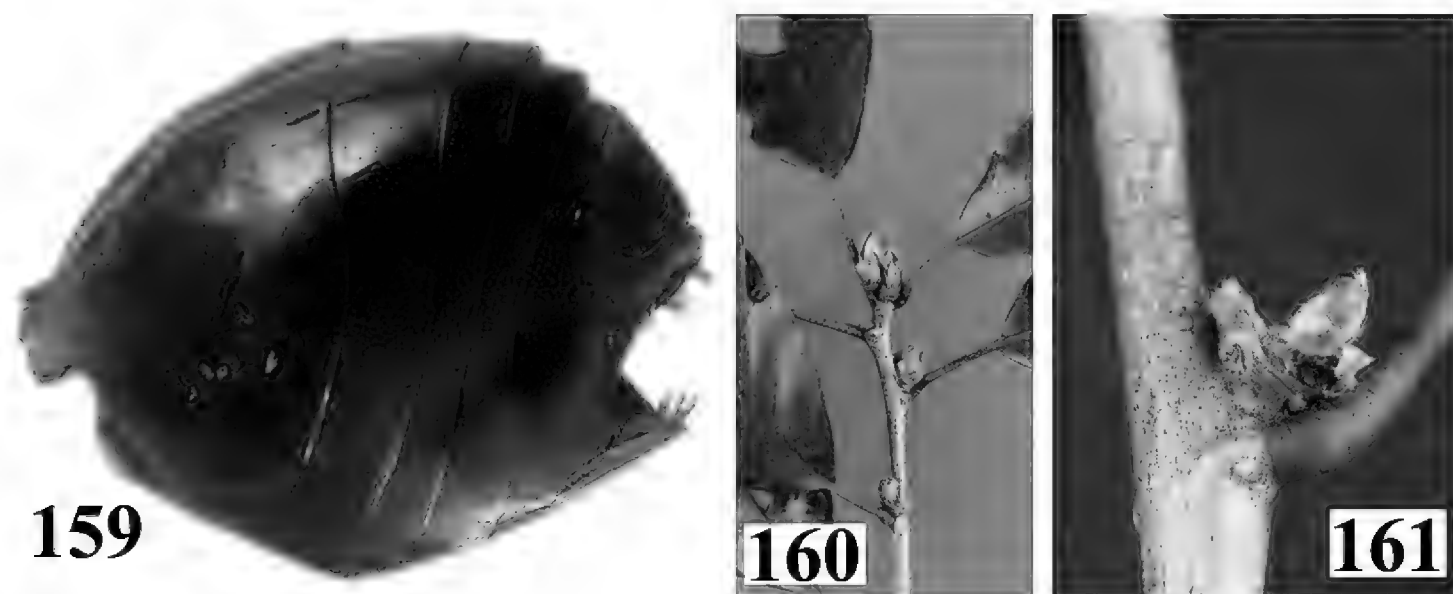
shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.10. OOL / diameter of lateral ocellus: 2.0. OOL / LOL: 2.0. Diameter of lateral ocellus / diameter of median ocellus: >1. Transfacial distance / eye height: 1.25. Diameter of torulus / intertorular distance: 1.70. Intertorular distance / eye torulus distance: NOT

CODED. Eye-torulus distance / diameter of torulus: 1.50. Lower face sculpture: alutaceous. Lower face pilosity color: white. Lower face pilosity density: rare. Clypeus convexity: flat. Clypeus sculpture: smooth. Clypeus ventral margin shape: straight. Clypeus reflectivity: glossy. Clypeus shape anterior view: rectangular. Clypeus pilosity: NOT CODED. Clypeus pilosity density: NOT CODED. Clypeus pilosity color: NOT CODED. Anterior tentorial pit: large, distinct. Epistomal sulcus: indistinct. Clypeo-pleurostomal line: indistinct. Frons sculpture: coriaceous. Frons pilosity density: rare. Frons reflectivity: matt. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: coriaceous. Interocellar area pilosity density: rare. Interocellar area reflectivity: matt. Interocellar area pilosity color: white. Vertex sculpture: coriaceous. Vertex pilosity density: rare. Vertex reflectivity: matt. Vertex pilosity color: white. Occiput sculpture: coriaceous. Occiput pilosity density: rare. Occiput reflectivity: matt. Occiput pilosity color: white. Postocciput sculpture: coriaceous. Postocciput reflectivity: matt. Postocciput pilosity: present. Postocciput pilosity density: rare. Postocciput pilosity color: white. Median impression of postocciput dorsal to occipital foramen: present. Posterior tentorial pit: distinct, ovate, deep. Impression adjacent ventrally to posterior tentorial pit: present. Postgena sculpture: alutaceous. Postgena reflectivity: glossy medially. Postgena pilosity color: white. Postgena pilosity density: rare. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: <1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 13. Antenna length / body length: <1. Pedicel length / pedicel width: 1.30. Pedicel length / length of broadened part of scape: NOT CODED. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: 1. F1 length / pedicel length: 1.75. F1 length / F3 length: NOT CODED. Flagellomeres relative length:  $F3 > F4 > F5 > F6 > F7 > F8 > F9 > F10 > F11 > F12$ .  $F4-F7$  relative length: NOT CODED.  $F3$  length/ $F2$  length: NOT CODED.  $F3$  length /  $F4$  length: NOT CODED.  $F8$  length /  $F7$  length: NOT CODED.  $F9$  length /  $F8$  length: NOT CODED.  $F10$  length /  $F9$  length: NOT CODED.  $F9-F11$  relative length: NOT CODED.  $F10$  length /  $F11$  length: NOT CODED.  $F12$  length /  $F11$  length: NOT CODED.  $F13$  length /  $F12$  length: 1. Placoid sensilla present on:  $F2-F13$ .

Mesosoma length lateral view / mesosoma height lateral view: 1.2. Pronotum sculpture: alutaceous with some rugae laterally. Pronotal dorsal row of setae count: present. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present anteriorly. Mesoscutum length / transscutal line: 1.1. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: adjacent. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: absent. Median mesoscutal line shape: NOT CODED. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteromedian line: ab-



sent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): coriaceous, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: white. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: rare. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width: >1. Disc of mesoscutellum sculpture: NOT CODED. Disc of mesoscutellum maximum width: in posterior 1/3. Scutellar fovea sculpture: smooth without longitudinal rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: NOT CODED. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 1.7. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular suclus count: NOT CODED. Mesopleuron sculpture: coriaceous, striae marking transepisternal line absent. Mesopleuron reflectivity: matt. Mesopleuron pilosity: few setae present along margin of lateral mesopleural face. Speculum sculpture: coriaceous. Speculum reflectivity: matt. Mesopleural triangle sculpture: coriaceous. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: NOT CODED. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: alutaceous with few rugae. Dorsoaxillar area reflectivity: NOT CODED. Dorsoaxillar area pilosity color: NOT CODED. Dorsoaxillar area pilosity density: NOT CODED. Lateroaxillar area sculpture: alutaceous with few rugae. Lateroaxillar area reflectivity: NOT CODED. Lateroaxillar area pilosity density: NOT CODED. Lateroaxillar area pilosity color: NOT CODED. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: >1. Metapleural sulcus anterior end: reaches mesometapleural suture in upper 1/3 of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: absent. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: smooth without striae. Metascutellum height / ventral impressed area of metanotum height: 1. Central propodeal area sculpture: coriaceous with few irregular rugae. Central propodeal area reflectivity: NOT CODED. Lateral propodeal carina shape: broad, high, lyre-shaped. Lateral propodeal area sculpture: smooth with transverse rugae. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: NOT CODED. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 3.6. Rs+M vs basalis: reaches basalis in lower half of its height. Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED. Metasoma length / head+mesosoma length: <1.



**Figures 159–161.** *Dryocosmus salicinai* sp. n. **159** metasoma, female, lateral view **160–161** galls (photos by C.-T. Tang).

Metasoma lateral height / metasoma lateral length:  $<1$ . 2nd metasomal tergite length dorsal view / length of metasoma dorsal view:  $1/3$ . Second metasomal tergite pilosity: present mediolaterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: NOT CODED. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, micropunctate. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: absent. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view:  $1.40$ . Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length:  $2.30$  mm ( $n=1$ ).

Male: Color: Head, mesosoma and metasoma dark brown; antenna brown; legs yellowish brown. Eye size vs female eye size: eye larger in male. Anterior tentorial pit size: NOT CODED. Diameter of lateral ocellus vs diameter of female lateral ocellus:  $1.40$ . Male diameter of torulus / intertorular distance: NOT CODED. Flagellomeres count: 13. Antenna length / body length:  $>1$ . F1 shape: F1 curved and broadened apically. F1 length / F2 length:  $1.3$ . Flagellomeres relative length:  $F2 > F3 > F4 > F5 > F6 > F9 > F10 > F11 > F12$ . F13 length / F12 length:  $1.2$ . Placoid sensilla present on: F2–F13. Body length:  $2.1$  mm ( $n=1$ ).

Gall (Figs 160–161): The unilocular gall is pink and ovate. One or two galls are embedded in one bud, which is usually flat and short. The gall is  $2.1$ – $2.6$  mm long and  $1.3$ – $1.6$  mm wide ( $n=5$ ). The presence of the gall interrupts the development of the shoot.

**Biology.** Only the sexual generation is known. Mature galls were collected in March and adults emerged from the galls under laboratory conditions in early April. This species induces galls on *Quercus salicina*.

**Distribution.** Taiwan: Heping District, Taichung City, and Renai Township, Nantou County. The distribution of *Quercus salicina* (Govaerts & Frodin, 1998) suggests the potential occurrence of this gallwasp species in Japan.

***Dryocosmus taitungensis* Tang & Melika, sp. n.**

<http://zoobank.org/B3BACB7F-F575-4E79-AA44-21ED50585781>

Figures 162–173

**Type material.** HOLOTYPE female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices, (TWTs16), em. 13.IV.2011, leg. Chang-Ti Tang. Twenty four female PARATYPES: 2 females with the same labels as the holotype; 2 females: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices, (TWTs16), em. IV.2011, leg. Chang-Ti Tang; 2 female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices, (TWTs16), em. 1.IV.2011, leg. Chang-Ti Tang; 1 female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices, (TWTs16), em. 2.IV.2011, leg. Chang-Ti Tang; 2 females: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices, (TWTs16), em. 4.IV.2011, leg. Chang-Ti Tang; 1 female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices (TWTs16), em. 5.IV.2011, leg. Chang-Ti Tang; 12 females: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 10.III.2011 (TWT473), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices (TWTs16), em. 7.IV.2011, leg. Chang-Ti Tang; 1 female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 8.I.2011 (TWT459), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices (TWTs16), em. 7.III.2011, leg. Chang-Ti Tang; 1 female: TAIWAN: Taitung Co., Lichia Village, Beinan Township, ex *Quercus hypophaea*, 8.I.2011 (TWT459), 22°47'47.27"N, 121°02'33.20"E, 767m, ex multilocular twig swelling with crevices (TWTs16), em. 14.III.2011, leg. Chang-Ti Tang.

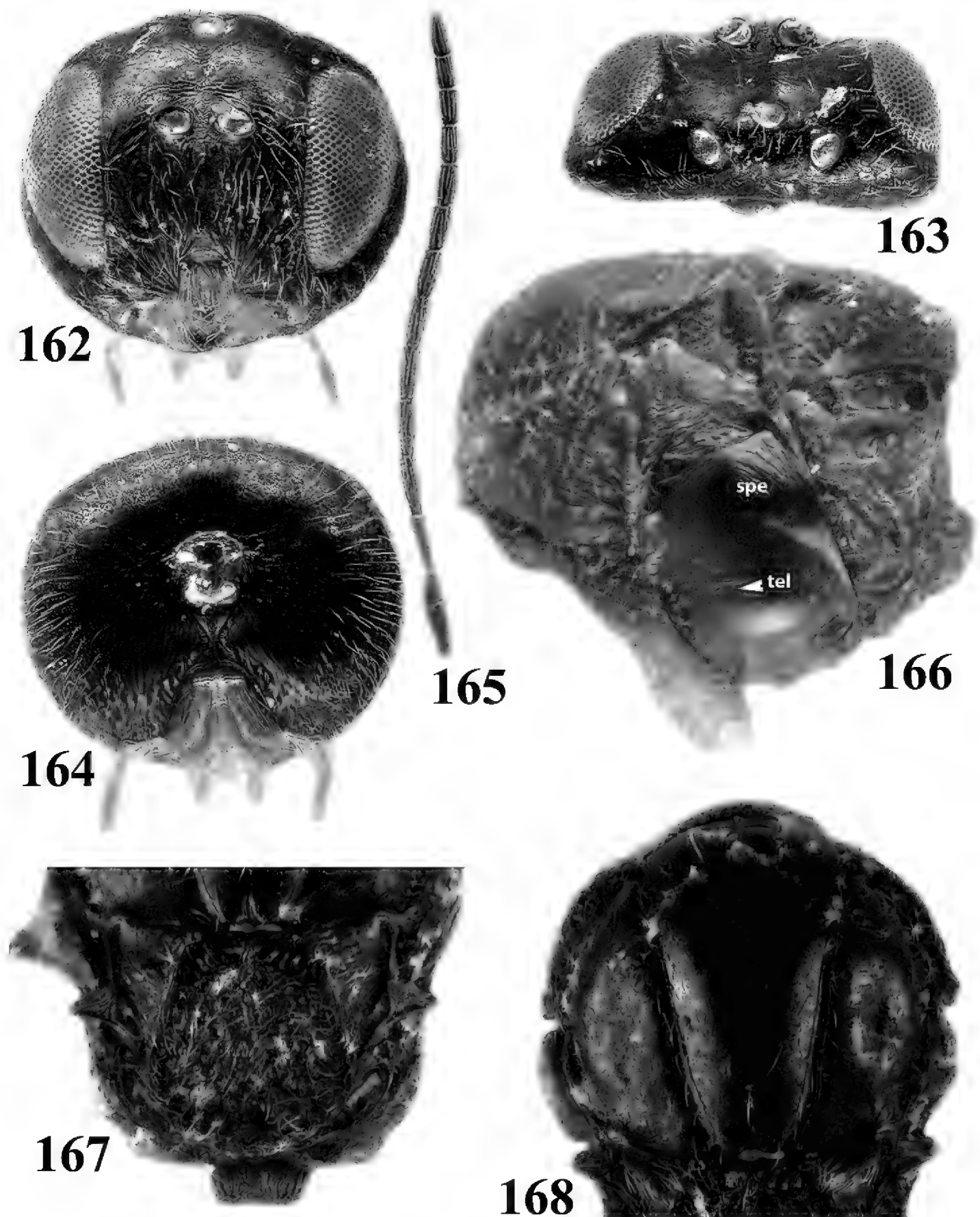
The holotype female, 6 female paratypes are deposited in NMNS, 7 female paratypes in PHMB, 4 female paratypes in USNM, 7 female paratypes in NCHU.

**Etymology.** Named after Taitung County, Taiwan.

**Diagnosis.** *Dryocosmus taitungensis* resembles *D. liyingi*.

*Dryocosmus taitungensis*: female head black; POL / OOL = 1.6; OOL / diameter of lateral ocellus = 1.58; OOL / LOL = 1.37 (Fig. 162); central propodeal area with longitudinal rugae; lateral propodeal carina slightly curved outward in mid-height (Fig. 169).

*Dryocosmus liyingi*: female head dark brown, with a light brown lower face, POL / OOL = 1.06; OOL / diameter of lateral ocellus = 2.1; OOL / LOL = 2.05 (Fig. 105); central propodeal area with distinct longitudinal rugae; lateral propodeal carina



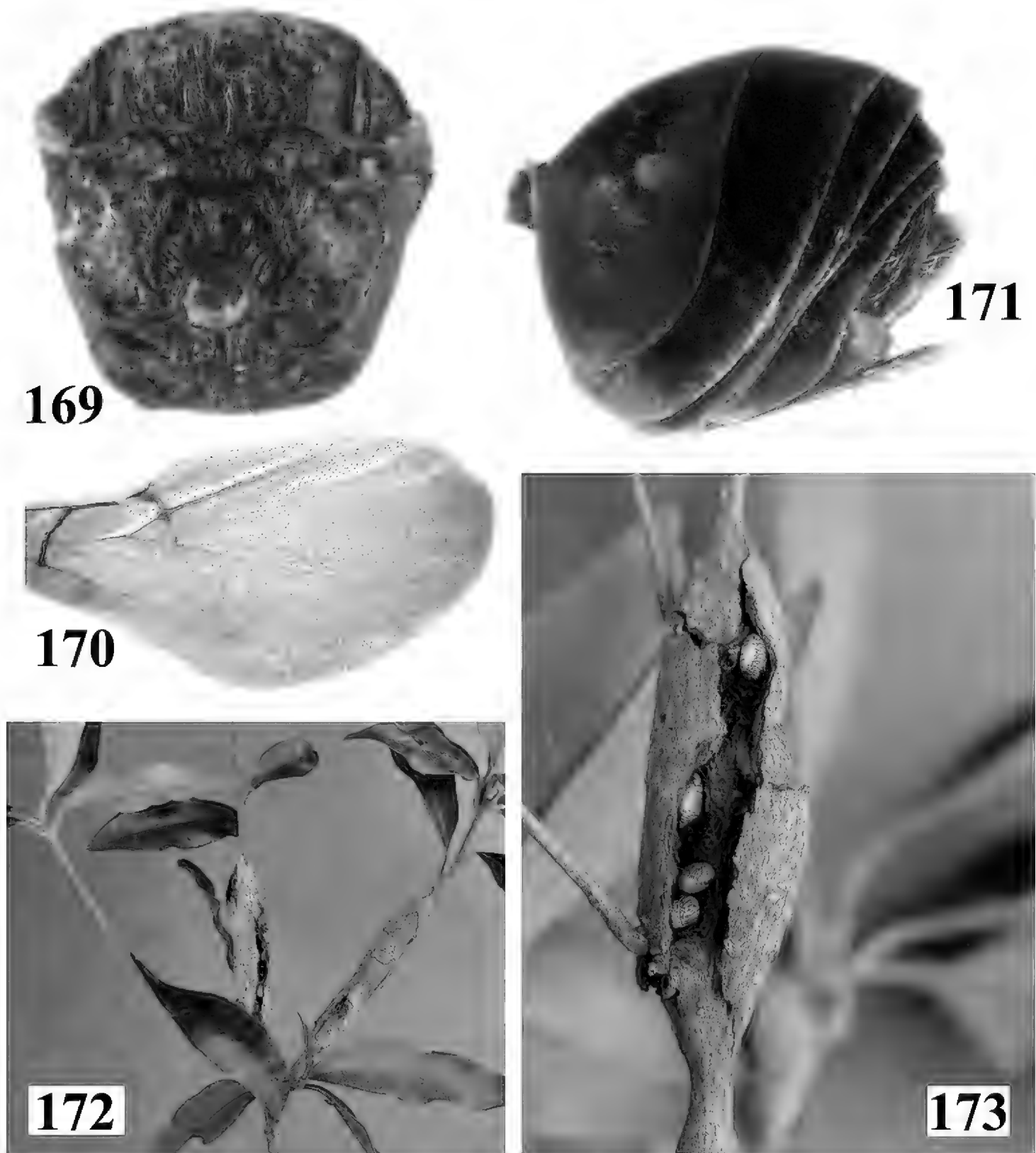
**Figures 162–168.** *Dryocosmus taitungensis*, female, sp. n. **162–164** head: **162** frontal view **163** dorsal view **164** posterior view **165** antenna **166** mesosoma, lateral view **167** mesoscutellum, dorsal view **168** mesoscutum, dorsal view (tel=transepisternal line, spe=speculum).

strongly curved outwards in the mid-height (Fig. 117). *Dryocosmus taitungensis* is also similar to *D. hualieni*, see diagnosis to *D. hualieni*.

**Description.** Asexual female: Head color: black, except for mandibles, maxillary and labial palps yellowish; scape, pedicel and F1 dark brown, F2–F12 darker. Mesosoma and metasoma color: black, except for lighter tegula; legs yellowish.

Head sculpture: coriaceous. Head shape anterior view: NOT CODED. Head width / head length: NOT CODED. Head width / head height: 1.20. Head width / maximum mesosoma width: <1. Gena sculpture: alutaceous. Gena reflectivity: NOT CODED. Gena length / eye width: 0.28. Gena shape: not broadened posterior to eye, not visible in frontal view. Malar striae count: present. Malar striae dorsal limit: torulus-eye line on lower face and lower eye margin on malar area. Malar area: alutaceous. Malar sulcus: absent. Eye height / malar distance: 3.33. Inner margins of eyes: NOT CODED. Median ocellus shape: NOT CODED. Lateral ocellus shape: NOT CODED. POL / OOL: 1.60. OOL / diameter of lateral ocellus: 1.58. OOL / LOL: 1.37. Diameter of lateral ocellus / diameter of median ocellus: 1. Transfacial distance / eye height: 1.00. Diameter of torulus / intertorular distance: 1.40. Intertorular distance / eye torulus distance: NOT CODED. Eye-torulus distance / diameter of torulus: 1.47. Lower face sculpture: NOT CODED. Lower face pilosity color: NOT CODED. Lower face pilosity density: NOT CODED. Clypeus convexity: convex. Clypeus sculpture: coriaceous. Clypeus ventral margin shape: straight. Clypeus reflectivity: NOT CODED. Clypeus shape anterior view: rectangular. Clypeus pilosity: present. Clypeus pilosity density: dense. Clypeus pilosity color: white. Anterior tentorial pit: small, distinct. Epistomal sulcus: distinct. Clypeo-pleurostomal line: distinct. Frons sculpture: coriaceous with transverse striae dorsal to toruli. Frons pilosity density: NOT CODED. Frons reflectivity: NOT CODED. Frons pilosity color: white. Impression around central ocellus: present. Interocellar area sculpture: alutaceous. Interocellar area pilosity density: NOT CODED. Interocellar area reflectivity: matt. Interocellar area pilosity color: white. Vertex sculpture: alutaceous. Vertex pilosity density: NOT CODED. Vertex reflectivity: matt. Vertex pilosity color: white. Occiput sculpture: alutaceous. Occiput pilosity density: NOT CODED. Occiput reflectivity: matt. Occiput pilosity color: white. Postocciput sculpture: NOT CODED. Postocciput reflectivity: glossy. Postocciput pilosity: absent. Postocciput pilosity density: NOT CODED. Postocciput pilosity color: NOT CODED. Median impression of postocciput dorsal to occipital foramen: NOT CODED. Posterior tentorial pit: small, distinct. Impression adjacent ventrally to posterior tentorial pit: absent. Postgena sculpture: smooth with delicate rugae medially. Postgena reflectivity: glossy medially. Postgena pilosity color: white. Postgena pilosity density: dense. Postgena pilosity count: absent medially, present laterally. Postgenal bridge / height of occipital foramen: 1. Postgenal bridge / length of oral foramen: <1. Postgenal bridge sculpture: NOT CODED. Number of flagellomeres (female): 12. Antenna length / body length: <1. Pedicel length / pedicel width: longer than wide. Pedicel length / length of broadened part of scape: 0.83. Combined length of scape and pedicel / first flagellomere length: NOT CODED. F1 length / F2 length: NOT CODED. F1 length / pedicel length: 1.7. F1 length / F3 length: NOT CODED. Flagellomeres relative length: F3>F4>F5>F6>F7>F8>F9>F10>F11. F4–F7 relative length: NOT CODED. F3 length/F2 length: NOT CODED. F3 length / F4 length: NOT CODED. F8 length / F7 length: NOT CODED. F9 length /F8 length: NOT CODED. F10 length / F9 length: NOT CODED. F9–F11 relative length: NOT CODED. F10



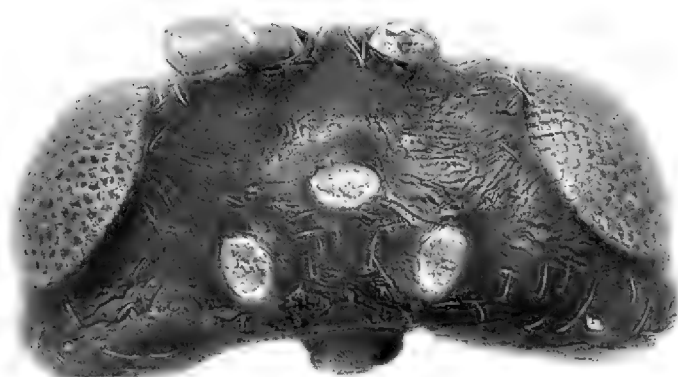


**Figures 169–173.** *Dryocosmus taitungensis* sp. n. **169** metascutellum and propodeum, female, postero-dorsal view **170** fore wing, female, part **171** metasoma, lateral view **172–173** galls (photos by C.-T. Tang).

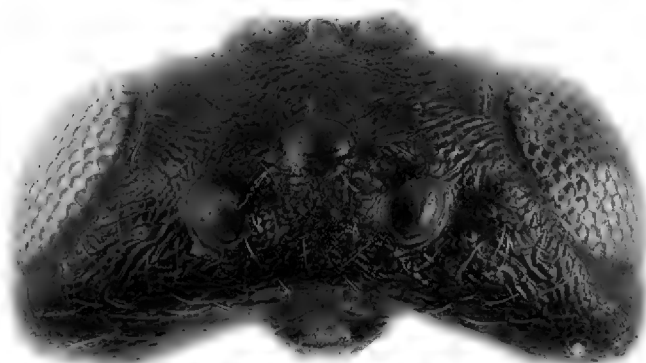
length / F11 length: NOT CODED. F12 length / F11 length: 1.67. F13 length / F12 length: NOT CODED. Placoid sensilla present on: F2–F12.

Mesosoma length lateral view / mesosoma height lateral view: 1.17. Pronotum sculpture: NOT CODED. Pronotal dorsal row of setae count: NOT CODED. Transverse pronotal sulcus depth: deep. Transverse pronotal sulcus sculpture: NOT CODED. Mesoscutum sculpture: smooth. Mesoscutum reflectivity: glossy. Adnotaular setae: present. Mesoscutum length / transscutal line: 1.14. Notaulus limits: well-impressed, posterior end adjacent to posterior margin of mesoscutum, anterior

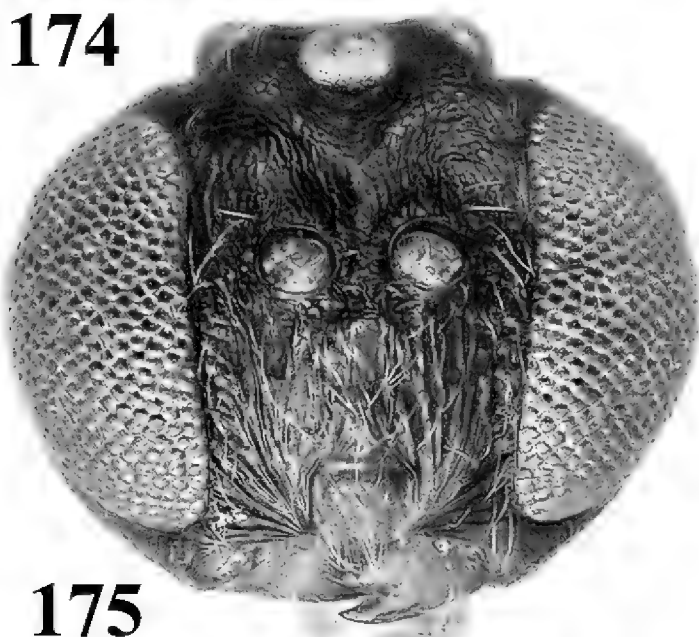
end adjacent to anterior margin of mesoscutum. Notaulus sculpture: NOT CODED. Notaulus posterior region width / anterior region width: NOT CODED. Mesoscutal suprahumeral sulcus anterior end vs notaulus anterior end: NOT CODED. Mesoscutal suprahumeral sulcus sculpture: NOT CODED. Median mesoscutal line: present. Median mesoscutal line shape: triangular. Parapsidal line: absent. Parapsidal line distinctness: NOT CODED. Anteroadmedian line: absent. Antero-admedian line length / mesoscutum median length: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae): rugose medially, foveolate laterally and posteriorly. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) shape: trapezoid. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity color: NOT CODED. Dorsomedian area of mesoscutellar-axillar complex (disc of mesoscutellum+axillar foveae) pilosity density: dense. Mesoscutellar axillar complex posterior margin vs metanotum: overhanging. Mesoscutellar-axillar complex length / mesoscutellar disc width:  $>1$ . Disc of mesoscutellum sculpture: rugose. Disc of mesoscutellum maximum width: in posterior  $1/3$ . Scutellar fovea sculpture: smooth with longitudinal, parallel rugae. Scutellar fovea shape: transversely ovate. Scutellar fovea reflectivity: glossy. Foveal septum: narrow. Anterior pits on foveal septum: NOT CODED. Scutellar fovea maximum diameter / scutellar fovea minimum diameter: 2.75. Scutellar fovea minimum diameter / foveal septum width: NOT CODED. Postacetabular sulcus count: present. Mesopleuron sculpture: smooth, transepisternal line is marked by few delicate sulci, area dorsal to transepisternal line smooth. Mesopleuron reflectivity: glossy. Mesopleuron pilosity: few setae present along margin of lateral mesopleural face. Speculum sculpture: striate dorsally. Speculum reflectivity: NOT CODED. Mesopleural triangle sculpture: rugose. Mesopleural triangle reflectivity: NOT CODED. Mesopleural triangle pilosity: present. Mesopleural triangle pilosity color: white. Mesopleural triangle pilosity density: rare. Dorsoaxillar area sculpture: smooth. Dorsoaxillar area reflectivity: glossy. Dorsoaxillar area pilosity color: white. Dorsoaxillar area pilosity density: rare. Lateroaxillar area sculpture: smooth. Lateroaxillar area reflectivity: glossy. Lateroaxillar area pilosity density: rare. Lateroaxillar area pilosity color: white. Subaxillular bar sculpture: smooth. Subaxillular bar reflectivity: glossy. Posterior height of subaxillular bar / height of metanotal trough: 1. Metapleural sulcus anterior end: reaches mesometapleural suture in upper  $1/3$  of its length. Metascutellum sculpture: coriaceous. Metanotal trough sculpture: smooth. Metanotal trough reflectivity: glossy. Metanotal trough pilosity: NOT CODED. Metanotal trough pilosity density: NOT CODED. Ventral impressed area of metanotum sculpture: coriaceous. Metascutellum height / ventral impressed area of metanotum height: 2.8. Central propodeal area sculpture: smooth with longitudinal rugae. Central propodeal area reflectivity: glossy. Lateral propodeal carina shape: broad, high, slightly curved laterally in mid-height. Lateral propodeal area sculpture: rugose. Lateral propodeal area pilosity: present. Lateral propodeal area pilosity color: white. Lateral propodeal area pilosity density: NOT CODED. Nucha sculpture: with delicate longitudinal rugae dorsally and laterally. Radial cell length / radial cell width: 5.  $Rs+M$  vs basalis: reaches basalis at half of its height.



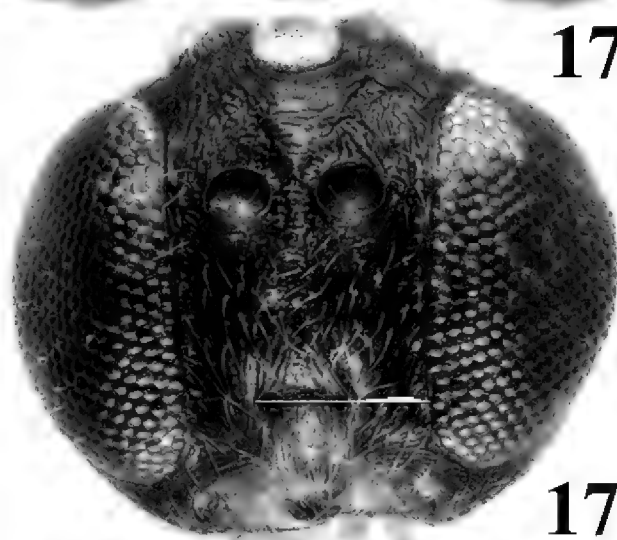
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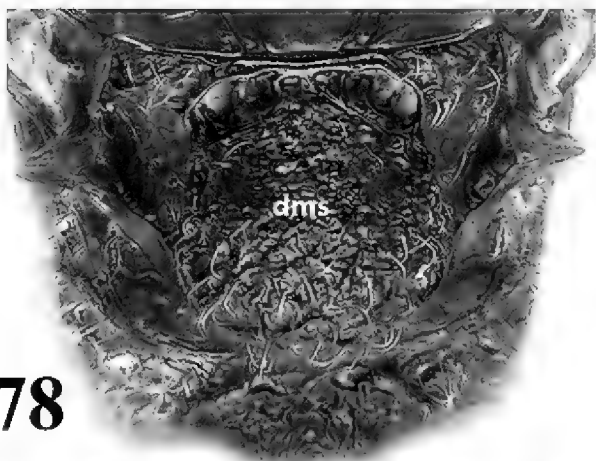
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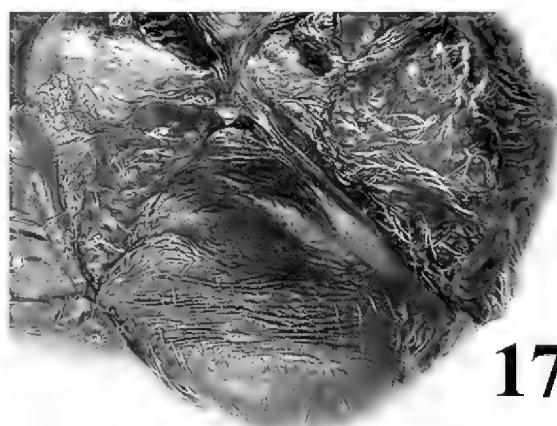
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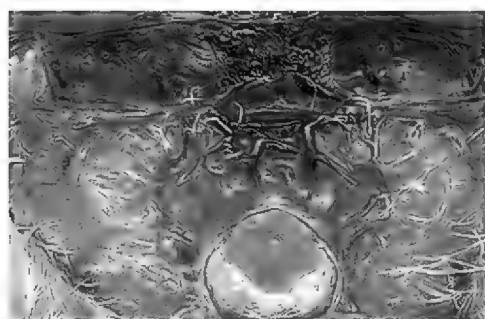
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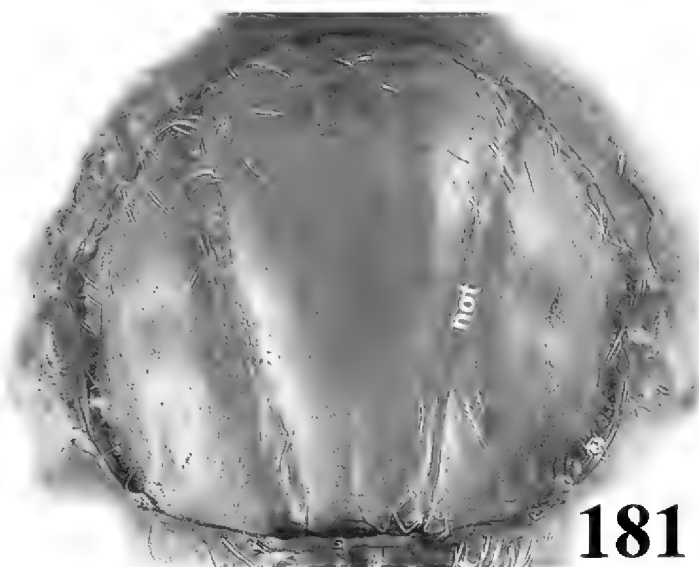
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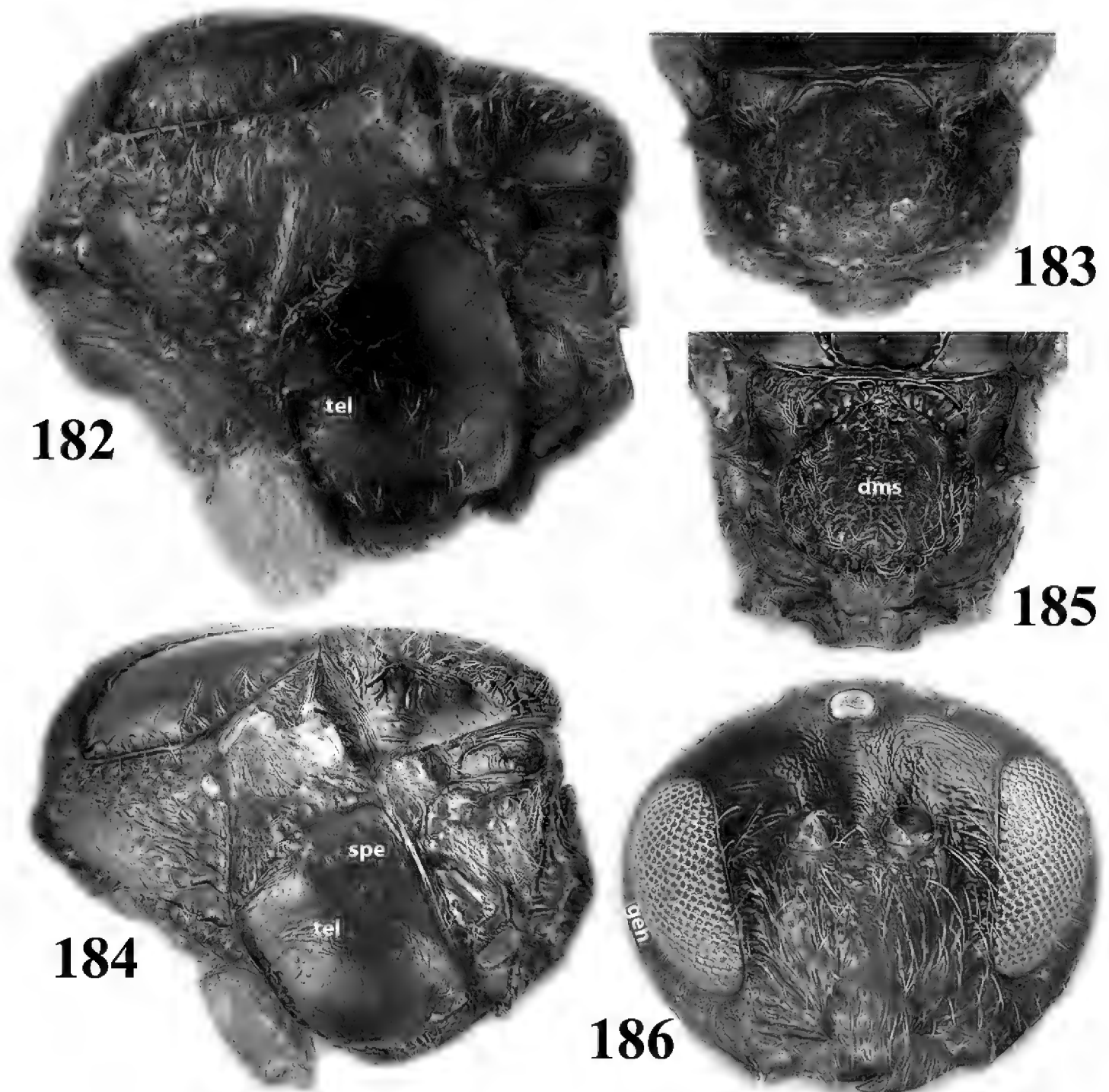


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181

**Figures 174–181.** 174–175 *Dryocosmus pentagonalis*: 174 head, female, dorsal view 175 head, male, frontal view. 176–177 *D. triangularis*: 176 head, female, dorsal view 177 head, male, frontal view 178–179 *D. pentagonalis*, female: 178 mesoscutellum, dorsal view 179 mesosoma, lateral view, part 180–181 *D. testismilis*, female: 180 central propodeal area, posterior view 181 mesoscutum, dorsal view (dms=disc of mesoscutellum, not=notaulus).



**Figures 182–186.** **182–183** *Dryocosmus carlesiae*, female: **182** mesosoma, lateral view **183** mesoscutellum, dorsal view. **184–186** *D. kuriphilus*, female: **184** mesosoma, lateral view **185** mesoscutellum, dorsal view **186** head, frontal view (tel=transepisternal line, dms=disc of mesoscutellum, spe=speculum, gen=gena).

Rs+M color: dark brown. Areolet: large, triangular, conspicuous. Marginal cilia: long. Rs distal end vs wing margin: adjacent to wing margin. R1 distal end vs wing margin: adjacent to wing margin. Basal lobe on metatarsal claw: absent. Basal lobe on tarsal claw shape: NOT CODED.

Metasoma length / head+mesosoma length: <1. Metasoma lateral height / metasoma lateral length: <1. 2nd metasomal tergite length dorsal view / length of metasoma dorsal view: 1/2. Second metasomal tergite pilosity: present laterally. Second metasomal tergite sculpture: smooth. Second metasomal tergite reflectivity: matt. Second metasomal tergite pilosity density: rare. Metasomal tergites 3–6 sculpture: smooth, no



micropunctures. Metasomal tergites 3–6 reflectivity: glossy. Metasomal tergites 3–6 pilosity: NOT CODED. Prominent part of ventral spine of hypopygium length ventral view / Prominent part of ventral spine of hypopygium width ventral view: 3.10. Hypopygial setae apical end: extending beyond posterior end of ventral spine of hypopygium.

Body length: 2.20–2.40 mm (n=5).

Gall (Figs 172–173): The multilocular gall is a stem swelling on the current year shoot. The gall is 8.4–29.2 mm long and 3.6–7.7 mm wide (n=7). Galls are located proximally on the branches, never apically, and are concolorous with the bark. The gall is brownish-red if the external layer peels off from the gall surface. The tissue of the mature gall is hard and lignified. During the winter the larval chambers fall to the ground, and the larvae overwinter in the leaf litter. Sometimes the larvae remain in the galls. Larval chambers are 2.5–3.3 mm long and 1.4–1.8 mm wide (n=10).

**Biology.** The period of the gall maturation, the absence of males, and the adult morphology suggest that the asexual generation is described here. Mature galls were found in January and adults emerged under laboratory conditions in March and April in the next spring.

**Distribution.** Taiwan: Taitung County, Beinan Township. *Quercus hypophaea* is an endemic of Taiwan (Govaerts & Frodin 1989), thus the described species might be also endemic to Taiwan.

## Discussion

East Asia harbours more than 70 species of the *Quercus* subgenus *Cyclobalanopsis* (Govaerts & Frodin, 1998). Despite this relatively high species richness, little was known about cynipine galls on *Cyclobalanopsis* until the recent description of the genera *Cycloneuroterus* Melika & Tang, 2011 and *Cyclocynips* Melika, Tang, & Sinclair, 2013 and new species of *Plagiotrochus* (Ide et al. 2010, 2012, 2013; Melika et al. 2013; Tang et al. 2011a, b, 2016a,b). Only one cynipine species, *Cycloneuroterus wangi* Abe, Ide, & Odagiri, 2014, has been reported to oviposit on *Cyclobalanopsis* outside Japan, Taiwan and Vietnam despite the wide Asian distribution (Abe et al. 2014) of this *Quercus* subgenus. Although *Dryocosmus* species have been collected in Yunnan province of southern China (Abe et al. 2014b) and in the Indochina region (Abe et al. 2014a), their host associations are unknown. Although all *Cyclobalanopsis* associated *Dryocosmus* species—including the five new species of the present paper—are known from Taiwan (Table 2), we can not confirm or deny if this restricted distribution is due to sampling bias.

While *Cyclocynips* and *Cycloneuroterus* are associated with *Castanea*, *Lithocarpus* and *Cyclobalanopsis*, the sole cynipine genus of *Castanopsis* is *Dryocosmus*. Our study doubled the number of *Dryocosmus* species associated with *Castanopsis*. With this new information, we can now clearly say that of all known Eastern Palearctic *Dryocosmus*, almost half (n=9) are associated with *Castanopsis* (Table 2). Eastern Palearctic species of *Dryocosmus* is known yet to associate with large and species rich *Quercus* subgenus *Quercus*.



**Table 2.** Eastern Palaearctic *Dryocosmus* species, their host plants, life cycles (sexual=known only from sexual generation; asexual=known only from asexual generation) and distributions.

<i>Dryocosmus</i> species	Host species	Life cycle	Distribution
<i>D. cannoni</i> Schwéger & Tang, sp. n.	<i>Castanopsis echinocarpa</i>	sexual	China
<i>D. caputgrusi</i> Tang & Schwéger, sp. n.	<i>Castanopsis uraiana</i>	sexual	Taiwan
<i>D. carlesiae</i> Tang & Melika	<i>Castanopsis carlesii</i>	sexual	Taiwan
<i>D. crinitus</i> Schwéger & Tang, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>morii</i> , <i>Q.</i> ( <i>C.</i> ) <i>sessilifolia</i>	sexual	Taiwan
<i>D. harrisonae</i> Melika & Tang, sp. n.	<i>Castanopsis echinocarpa</i>	sexual	China
<i>D. hearni</i> Melika & Tang, sp. n.	<i>Castanopsis</i> sp.	sexual	China
<i>D. hualieni</i> Schwéger & Tang, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>glauca</i>	asexual	Taiwan
<i>D. konradi</i> Tang & Melika, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>longinux</i>	sexual	Taiwan
<i>D. liyingi</i> Melika & Tang, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>morii</i> , <i>Q.</i> ( <i>C.</i> ) <i>sessilifolia</i>	sexual	Taiwan
<i>D. moriius</i> Tang & Melika, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>morii</i>	sexual	Taiwan
<i>D. nanlingensis</i> Abe, Ide, & Odagiri	unknown	sexual	China
<i>D. okajimai</i> Abe, Ide, Konishi & Ueno	unknown	sexual	Vietnam
<i>D. pentagonalis</i> Melika & Tang	<i>Castanopsis carlesii</i>	sexual	Taiwan
<i>D. quadripetiolus</i> Schwéger & Tang, sp. n.	<i>Castanopsis echinocarpa</i>	sexual	China
<i>D. sakureiensis</i> Ide, Wachi & Abe	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>acuta</i>	sexual	Japan
<i>D. salicinai</i> Schwéger & Tang, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>salicina</i>	sexual	Taiwan
<i>D. sefuriensis</i> Ide, Wachi & Abe	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>acuta</i>	sexual	Japan
<i>D. taitungensis</i> Tang & Melika, sp. n.	<i>Quercus</i> ( <i>Cyclobalanopsis</i> ) <i>hypophaea</i>	asexual	Taiwan
<i>D. testisimilis</i> Tang & Melika	<i>Castanopsis uraiana</i>	sexual	Taiwan
<i>D. triangularis</i> Melika & Tang	<i>Castanopsis carlesii</i>	sexual	Taiwan
<i>D. kuriphilus</i> (Yasumatsu)	<i>Castanea crenata</i> , <i>C. henryi</i> , <i>C. mollissima</i> , <i>C. seguinii</i> , <i>C. dentata</i> , <i>C. sativa</i>	asexual	Holarctic
<i>D. zhuili</i> Liu & Zhu	<i>Castanea henryi</i>	sexual	China

Most oak gallwasps are cyclically parthenogenetic, with obligate alternation between a sexual and an asexual (unisexual) generation. Males and females of the sexual generation usually occur at the same time as the flush of new growth on host plants in the spring, while the parthenogenetic females of the asexual generation occur in the winter (Csóka et al. 2005, Abe et al. 2014b). Of the 22 described Eastern Palaearctic *Dryocosmus*, no species are known to have alternate sexual and asexual generations; asexual specimens are known for four and sexual for 18 species (Table 2). Likewise, a significant proportion of other Holarctic cynipine species are known from only one of the two generations (Melika 2006). Stone et al. (2008) confirmed that many of these species actually do have a sexual generation (Stone et al. 2008) and it is likely that alternate generation of many East Asian *Dryocosmus* species are yet to be described.

The above mentioned uncertainties about the distribution, host association and biology of Eastern Palaearctic *Dryocosmus* species demonstrate that research on this taxon is still in its infancy. Further studies applying refined morphological and molecular methods on freshly collected Eastern Asian specimens is needed to galvanize life into the non-functional systematics of the likely polyphyletic *Dryocosmus* (Melika et al. 2010).

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## Supplementary material I

**URI table (Seltmann et al. 2013) containing anatomical terms, definitions and uniform resource identifiers of Hymenoptera specific classes in the Hymenoptera Anatomy Ontology (<http://hymao.org>).**

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Data type: PDF file

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## Supplementary material 2

**Semantic statements of natural language phenotypes composed in Protégé 5.0 (<http://protege.stanford.edu/>) using the OWL Manchester syntax.**

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